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ABSTRACT

Thirteen papers from a symposium on technology in education and communications for the deaf are presented. The following papers are included: "Technology Trends in Special Education" (Blaschke); "Microcomputer Usage in American Schools for the Deaf The State of the Art" (M. Deninger); "Management and Computers" (P. Mackall); "The Computer as an IEP Resource" (D. Spidal); "Microcomputer Software/Courseware Evaluation" (R. Storm); "Closed Captioning and the Line 21 System--Possibilities for the Future" (D. Popkin); "Uses of Automatic Speech Recognition to Facilitate Speech Communication for Deaf and Hearing Impaired Persons" (S. Revoile); "Electronic Mail for the Deaf--Will It Work?" (E. Craighill). The final four papers focus on technology applications for the deaf in terms of administration (D. Gjerdingen); teachers (G. Gustason); employment (S. Jamison); and rehabilitation (J. Tingley). (CL)

WORKING PAPERS

SYMPOSIUM ON APPLICATIONS OF TECHNOLOGY IN EDUCATION AND COMMUNICATIONS FOR THE DEAF

April, 1984

Disseminated by
NATIONAL ASSOCIATION OF STATE DIRECTORS OF SPECIAL EDUCATION
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CONTENTS

PREFACE

In his concluding comments in the enclosed article, "Microcomputer Usage in American Schools for the Deaf: The State of the Art", Michael Deninger, Dean of the Kendall Demonstration Elementary School at Gallaudet College, notes the following:

> We are still in the infant stages of finding and realizing systematic and effective applications of software for instruction that makes a difference in terms of student achievement. In fact, this should be the benchmark against which we measure the success of any instructional intervention. Computers must stop being an end unto themselves and begin finding their rightful and appropriate place in the education of our students. Careful planning can accomplish just that. We need to "pool" our collective experience and realize that we are in no worse shape than the public schools--probably in much better shape! There is no reason why we, as educators of the deaf, cannot lead the field of education with new computer innovations as we have led the field of education with other innovations in the past.

In this concise summary, Deninger reflects the need identified in 1983 by the Office of Special Education Programs, U.S. Department of Education to provide assistance in the area of applications of technology in the education of the deaf.

In responding to this need ED/OSEP provided funds through a contract with the National Association of State Directors of Special Education, Inc. to conduct a two-day symposium for educators of the deaf nationally. The purpose of the symposium was to provide state-of-the-art information, demonstrations and futuristic visions and ideas to facilitate improvements in the applications of technology in all programs serving deaf youngsters.

That symposium was held in April, 1984 in Los Angeles, California in conjunction with the annual meeting of the Conference of Educational Administrators Serving the Deaf (CEASD). Appropriately, the symposium was titled "Agenda for the Future: Applications of Technology in Education and Communications for the Deaf." More than 200 persons, including administrators, teachers, and support personnel in programs for the deaf from nearly 40 states participated in that symposium, which featured 28 persons in presenting roles.

The 13 articles included on the following pages are intended to capture the essence of that symposium.

We believe that any person involved or interested in the education of deaf children will find something of use and/or interest in these pages. Thus, we hope this document will serve to accelerate the momentum toward increased usage of technology in programs serving the deaf in the United States.

NASDSE owes a debt of gratitude to each of the authors of the papers enclosed, to the planners, presenters and participants of the Los Angeles Symposium, and to the U.S. Department of Education for its leadership in addressing this important area of education of the deaf.

TECHNOLOGY TRENDS IN SPECIAL EDUCATION

Charles L. Blaschke
Education Turnkey Systems, Inc.

Electronic learning technology has become a reality in public education. The dramatic growth in the use of microprocessor-based systems, telecommunications, and related technologies in education can be attributed to: (a) rapidly decreasing cost of hardware relative to speed and capacity; (b) pressures from parents as microcomputer home use has greatly increased; (c) grassroots initiatives from "computer buffs" within schools; (d) availability of Federal and some state funds through "block" grants; (e) Federal deregulation, particularly in the telecommunications area; and (f) political pressures from governors and legislatures upon SEAs, of which virtually all now have policies on education technology.

The use of electronic learning technology in special education has increased even more dramatically due to the above factors and additional ones. The purpose of this paper is to describe current and future trends related to the potential use of microcomputers, videodiscs, telecommunications systems, and communication aids and devices for special education generally.

Since 1981, Education TURNKEY Systems has collected and compiled data bases and trend information related to user needs, technology advances, and relevant applied research and development. Through Project SpEd, TURNKEY developed three-year scenarios on various technology applications in special education, based upon interviews with over 200 publishers and developers of software products. In Project Tech Mark, we conducted an extensive market research analysis which was provided to publishers and developers to encourage their development of products specifically designed for special education populations. Through Project SLATE, which is designed to assist state-level policy makers (including legislators and governors) to develop plans for the effective use of technology, TURNKEY staff have been able to monitor changing user needs and the evolution of state policies. And most recently, through NASDSE's SpEd Tech Center Project, the TURNKEY conducted a needs assessment survey related to technology use of all state directors of special education and planned the first annual R&D Symposium on special education technology. Many of the current trends and projections presented below are based upon one or more of the above projects and/or studies.

Why Technology In Special Education?

The significant growth and use of electronic learning technology in special education that has occurred over the last few years, particularly microcomputers and communication aids, can be attributed to a number of factors.

First, the passage of P.L. 94-142 and mirror image state laws have generated a demand for technology use in both instruction and administration. One of the findings from our study of the impact of P.L. 94-142 upon LEAs, conducted in the late 70s, found that a typical teacher spent over 10 hours per year per child developing and updating IEPs. Recent evaluations in

Wayne-Westland, Michigan and elsewhere have reported that the use of administrative packages on low-cost microcomputers can reduce the time per pupil to about an hour to develop an IEP and 10 minutes to update it. In addition, many LEAs have found that the microcomputer can reduce routinized staff time and paperwork associated with assuring other procedural safeguards. By requiring an IEP for every child, including those in mainstream settings, the law generated a demand for instructional management systems which could monitor individual progress of students who are at varying levels and are proceeding at different learning rates. In many instances, the use of computer-assisted instruction, particularly as supplemental and enrichment activities and as reinforcement mechanisms, can further enhance the individualization process.

Second, the monies allocated to special education have increased dramatically over the last decade. For example, in 1976 approximately $4.6 billion was allocated to special education by Federal, state and local education agencies. In 1983, the total funding increased to over $12 billion with a projected increase by 1985 to approximately $15 billion. Once considered a "thin market" by publishers, the courseware and software developers and electronic publishing firms have been more responsive to special education than education generally, especially over the last year or so. In addition, trade associations, such as the National AudioVisual Association, have projected a higher rate of increase in per pupil expenditures in special education for instructional equipment and materials than in education generally, from $367 million (1982) to $650 million in 1985. This has provided further inducement for the private sector to attempt to penetrate and/or expand its market share in special education.

Third, the cost of providing services to handicapped students is significantly higher than those associated with services for nonhandicapped children. A comparison based upon a study conducted by the Rand Corporation in 1980 indicates that in the area of administrative processing and overhead, the costs associated with handicapped students are approximately $500 per year compared to $200 per year per nonhandicapped child. These adminstrative processing costs, combined with an additional $200 to $300 related to IEP development, suggest that a software package cost of $2,000 could pay for as few as 20 students if staff time and paperwork could be reduced by as little as 25 percent.

Fourth, as parents of handicapped children become increasingly aware of the potential use of communication aids and devices interfaced with commercially available microcomputers, they, too, are bringing pressures upon LEAs and SEAs to make these systems available for the handicapped child in school and/or in the home environment.

And last, a number of SEP-funded projects have also provided funds and other incentives for expanded use of technology in special education.

Microcomputer Use and Trends

By December 1983, approximately 350,000 microcomputers (general purpose microcomputer vs. single dedicated hardware/software systems) were in the public schools. About 60,000 were used primarily for special education. Of these, 15,000 were used for administrative purposes. Joint use was identified in about 20 percent of the LEAs. By 1985-86, approximately 500,000 microcomputers will be in the public schools with some 150,000 used primarily for special education. An estimated 30,000 will be used for administrative purposes.

- Instructional Application and Needs. The National Needs Assessment Study, conducted by TTS (1980), identified a number of "perceived needs" (on the part of special education teachers and administrators) in reading, word attack skills, math, and social-behavior content areas. The study also identified a demand for computer assisted instruction (e.g., for every one teacher with a child receiving CAI instruction in 1978, five additional teachers felt that CAI was the most appropriate delivery system for instruction in high priority curriculum areas). The CEC conference (march, 1983) responses reflect significant changes in priority courseware curriculum/content areas. For examples, while 48 percent of the attendees felt reading and other language arts courseware was still their highest priority need, only 4 percent felt that math courseware was a priority need. Evidently, the large number of math courseware packages is meeting priority special education needs, with and without adaptation. On the other hand, approximately 20 percent of the CEC conference attendees felt a priority need for computer literacy courseware. This is slightly less than the general demand for computer literacy via CAI as reported by Anderson's 1982 survey, which found that 35 percent of teachers who had access to at least one microcomputer felt that CAI was the most appropriate delivery of computer literacy curriculum.

  Over the last year, special education administrators, particularly in urban districts, have expressed an increasing need for tutorial-type programs used for introducting concepts, although problem solving and drill-and-practice still constitute approximately 60 percent of the top priority instructional courseware needs. In 1983, however, three firms (DLM, Random House, and Hartley courseware) released over 100 programs which allow special education teachers to adapt or adjust the courseware for special education students. Adjustable simulation programs will emerge within one year.

- Priority Needs for Administrative Applications Changing. The CASE survey, conducted in the Fall of 1982, found that the overwhelming number of administrative packages which were commercially purchased (68 percent) or developed internally (80 percent) were of a single-purpose nature. Priority single-purpose applications included: student enrollment (94 percent); student tracking (45 percent); student program to monitor student's education programs (40 percent); budget monitoring and reporting (23 percent); word processing (22 percent); and assessment (12 percent).

Only about 30 percent of the administrators using computers in special education used multipurpose programs, while approximately 80 percent of the CASE respondents used microcomputers, mainframes, and minis. While about 50 percent of the CEC attendees identified CAI as a priority type of software need, approximately 15 percent felt a priority need for direct support by teachers such as CMI, diagnosis and prescription; 20 percent for administrative support such as student records, IEP printing, and tracking; and 3 percent for test scoring and analysis.

In addition, 45 percent of the CEC attendees stated that their district plans call for increased use of microcomputer technology in both special education adminstration and instruction. Most recognized the need for multipurpose programs. This perceived need is consistent with our findings from a year ago and from discussions with a number of special education administrators. Moreover, multipurpose applications are more likely to be purchased than developed internally. Approximately 50 commercially available multipurpose packages were available in 1984 and are being used in special education administration. Interestingly, about 50 percent of the participants in workshops we have conducted over the past two years felt that the need for microcomputer administrative applications would still be high, even if state or Federal requirements mandated in P.L. 94-142 were to be significantly reduced.

Before the end of this year, at least one client- customizing multipurpose administrative package will be available for individual LEAs and schools and for SEA/LEA networks. Under a Small Business Innovation Research program contract, we are presently field testing a client-customizing version of the Modularized Student Management System for use by LEAs and SEAs across the country. If the field test results are successful, we anticipate that costs will be reduced by as much as 50 percent. In addition to client-customizing packages, a number of states are using data base management programs to develop both single and multipurpose administrative applications. We expect these systems to be used increasingly along with program generators. In the next two years, we anticipate the emergence of several instructional management packages, which will be built upon artificial intelligence research and development transferred from the defense and other areas to act as an expert systems "tool" for managing the education process for special education populations. Several groups in Tennessee, California, Michigan, and Canada are developing various types of expert systems for use in the schools.

- Special Education Courseware Distribution Differs Significantly from Regular Education. A TALMIS report (1983) found that approximately 41 percent of all courseware purchased by schools was purchased from retail outlets such as Computerland, Radio Shack retail outlets, etc. Only 13 percent was purchased from traditional audiovisual dealers and school suppliers. Attendees at the CEC conference indicated that approximately 30 percent of their courseware was purchased from education dealers or sales representatives, while only 17 percent was purchased from commercial retail outlets. Approximately 19 percent was purchaseddirectly from publishers through catalogues, etc. In addition to a heavier reliance upon education dealers and sales "reps," special education consumers purchased a surprisingly large amount of software through direct mail or catalogues, even though one survey found that mail was the "least preferred marketing strategy" to help them make special education courseware decisions. Electronic distribution of courseware through state-operated and/or subscription services is now a reality and can be expected to spread over the next year or two. This technology, along with alleged copying by schools, will drive even more courseware publishers to the home market or out of business.

- In-House Software Development a Mixed Bag. While SpEd respondents felt that they would be more likely to develop in-house administrative, single-purpose applications than instructional courseware, CEC attendees indicated that approximately 40 percent of noncommercial software which they use was developed in-house; only 8 percent, mostly administrative, was developed by outside groups. Surprisingly, less than 5 percent of noncommercial software was obtained from other LEAs or intermediate units. On the other hand, approximately 25 percent of the CEC respondents felt a great priority need for assistance in adapting or modifying software for special education students, which has implications for courseware developers/publishers. Publishers interested in the special education market should reconsider restrictive copyright policies to allow LEAs to adapt courseware.

* Other Changing Needs. Priority information needs identified by CEC attendees (March 1983) indicate that "computer literacy/orientation" is still a major need (50 percent); however, reflecting a degree of maturation on the part of special education administrators and teachers, the demand for comparative information on specific applications is increasing (28 percent), while the need for comparative information on hardware has dropped to less than one percent. Interestingly, priority needs for comparative information on adaptive devices have increased significantly between 1982 and 1983, with approximately 13 perent of the CEC attendees indicating this as a high priority information need.

  While assistance in selecting appropriate software remains the highest technical assistance need for districts, a surprising number of CEC attendees reported a priority need for assistance in systematic planning for the use of technology in special education (31 percent). This is interesting in light of the fact that 75 percent of the Hartford attendees had one or more microcomputers presently being used in special education. Evidently, districts first experiment with micros in special education and then recognize a need for systematic planning, particularly in light of tighter budgets and reductions in Federal funds.

Telecommunication Trends

Experimental use of telecommunications systems has not been uncommon in the deaf community, with such efforts as Deafnet, Baudot compatible TDY systems, and other networks, operated by Gallaudet College and other groups. In special education generally, telecommunications has been limited to electronic mail and bulletin board systems, using networks such as SpecialNet, which is a subsystem of GTE Telenet. SpecialNet is the largest education electronic mail/bulletin board system in the country, with over 2,000 SEA and LEA subscribers in December 1983. Both LEAs and parents of handicapped students are increasingly using other telecommunications networks such as CompuServe, which is particularly popular in the Midwest among farmers and agriculture extension agencies. In addition, two SEP-funded projects will establish information exchanges on software and on techology applications with a particular focus upon SEAs, LEAs, and parents of handicapped students.

The recent advances in telecommunications systems and networks can be attributed to a number of factors. First, the amount of deregulation by the FCC and other Federal regulatory agencies over the last two years, providing new opportunities for commercial use. In some instances, this deregulation has been at the expense of education and the special education community. For example, in April 1983, the FCC deregulated the use of the FM subcarrier to allow for commercial use that previously had been dedicated to other services for the handicapped. Subsequent deregulation of ITFS stations for commercial use has the potential of removing such capabilities from state education agencies which have failed to use dedicated channel capacity.

Second, the "terminal-end" equipment base has increased dramatically as microcomputers have invaded the school and home. This equipment base, combined with new adavnces in low-cost modems and other related peripherals, provides a unique opportunity for increasing subscriber bases and, hence, investment in development of data bases and programs.

Third, significant advances have occurred in the use of voice and data transmission technology, including fibreoptics. And last, standards are beginning to emerge in such areas as videotext as giants of the communication industry, such as CBS, AT&T and others, have created joint ventures. The establishment of standards in this area will significantly increase videotext use throughout the country at the expense of many telecommunication firms which "bet" on other standards.

Trend Predictions

Over the next two or three years, a number of significicnt trends in the use of telecommunications will occur in education, including electronic distribution of software and courseware.

A survey in 1983 found that one of the highest priorities among state directors of special education was the creation of SEA/LEA networks and telecommunications systems. Most of these networks now consist of microcomputers at the LEA level, tied into larger "mega micros," mini, or mainframe computers at the state level. LEAs can use the systems for developing and upgrading IEPs. SEAs use them for desk audits, monitoring, and reporting purposes. Such systems are operational in Louisiana and Alaska, and can be expected in other states, such as West Virginia which now has a microcomputer-based network designed for use in vocational education.

While on-line distribution networks, such as that in West Virginia, can be expected to be used for reporting purposes, a number of other states are seriously exploring the possibility of newer, lower cost broadcast systems for both electronic mail and courseware distribution. For example, New York State is planning to use the recently deregulated FM subcarrier or vertical blanking space (videotext) for broadcast of electronic mail software evaluations, and is actually distributing courseware to local school systems. One such network is represented by INC, a joint venture of National Public Radio and National Information Utilities.

Pilot demonstrations of the INC system are planned for Maryland, Virginia, and several other states over the next year. While the costs of such a system are significantly lower than existing telecommunications systems such as The SOURCE, CompuServe and SpecialNet, the technology still remains somewhat "dirty," requiring several broadcasts of courseware for example. In its present configuration, the NIC system could distribute courseware to "information utilities" located at the school district or community level, which would be accessible to parents or individual students at learning stations with low-cost, semi-smart terminals costing less than $100.

As telecommunication systems using broadcast FM, videotext, or even on-line distributive networks emerge in communities, the opportunities will grow for increased and improved relationships between parents and LEA staffs. Several California communities are experimenting with such systems, allowing parents to tap into the records of their students and for LEA staff to provide messages via electronic mail to parents. Opportunities for more efficient involvement of parents in procedural safeguards such as developing and updating IEPs, parent conferences, etc., will be enhanced. In addition, opportunities for parents to coordinate homework and supplemental instruction at home could be increased significantly, as one of the major information requests on the part of parents of handicapped children has related to the selection of appropriate courseware and adaptive devices for their use in the home.

Videodiscs. Most of the Department of Education-funded research and development of videodisc technology in education has focused on handicapped populations. The pioneering work of Utah State University through Hofmeister and Thorkildsen and the University of Nebraska (Nuegent) illustrate the point. However, over the last four years, use by LEAs can be characterized as a "chicken and egg game." On one hand, LEAs have been hesitant to purchase videodisc equipment because of the lack of educational programs. On the other hand, software developers and production units have not been producing programs because of the inadequate equipment base in the schools. During the last six months, the situation has changed rather dramatically. The current issue of Electronic Learning is devoted to videodisc systems for education.

First, LEA purchases of videodisc equipment increased from approximately two percent of the districts with one or more videodiscs in June 1982 to about 20 percent in September 1983. Approximately 70 percent of the large urban districts plan to have videodisc units in use by the end of 1984.

Second, while most educators within LEAs and many developer firms have been betting on the laser optical disc, major breakthroughs occurred in the freeze-frame capability and random access speed of the capacitance disc.

Third, as the use of videodisc technology increased in industry training, point of sales, and in military training, production has also increased and costs have dropped rather dramatically over the last year.

And Fourth largely as a result of the above trends, a number of large firms are investing in videodisc program development and production designed for education use. For example, under a two-digit million dollar contract, Utah State is designing 70 one-hour videodisc programs on math, science, and technology in education. Firms such as SVE and MicroEd have joined forces to produce and market programs which can be tied into the new interface devices prevalent in some computers such as Commodore. Other electronic learning publishers, such as Grolier, are expanding their videodisc program lines. At this time, software developers who have produced and marketed courseware on floppy disk (which are difficult to protect) are converting to videodisc formats which offer significant protection against illegal copying and pirating due to the high cost of videodisc program reproduction. Videodisc program sales are expected to approach $600 million by 1987-1988. Industry sources project that approximately 20 to 30 percent of these sales will be directly to LEAs or the home education market.

Communication Aids and Devices. By 1981, two courseware firms had developed courseware packages which interface with communication devices such as voice synthesizers or voice input devices. Today, approximately 75 percent of the producers and publishers of the software which is designed for, or could be used in, special education provide opportunities for at least one of their packages to be interfaced with one or more adaptive devices. Primary factors contributing to this increase are:

The cost of these devices has dropped significantly over the last two years as production has increased dramatically, because of their use by handicapped persons in the workplace and/or for general entertainment in the home. For example, the ShadowVet, produced by Scott Instruments, retailed for approximately $1,000 in 1982. In 1983, the unit was selling for less than $400.

Major technology advances -- for example, Texas Instruments has developed one of the most sophisticated voice recognition and voice entry systems which can recognize up to 500 words initialized by the user. Borg-Wagner Education System, a major producer of special education software and products, recently announced the UFONICS system, a digitized voice (as opposed to a synthetic voice) which is being interfaced with existing courseware developed by firms such as MECC and others. The UFONICS system retails for less than $600.

Increased parent awareness of these adaptive devices, which can be attributed to both legitimate awareness arising from the Johns Hopkins First National Contest on Pesonal Computers for the Handicapped, as well as overzealous advertising on the part of vendors. Independently, parents are purchasing these devices for use at home with their handicapped children. And in combination with lawyers, a limited number of parents are attempting to pressure LEAs to purchase and use these devices, particularly in mainstreamed settings, so that their children (particularly hearing-impaired and sight-impaired) can access computer-assisted instruction used by nonhandicapped students. These pressures may be less subtle, as lawyers threaten to sue school districts under Section 504 of the Rehabilitation Act to provide "reasonable accommodation" for handicapped students.

Over the next two or three years, increased opportunities for robotics applications, either in the educational process or as a support system for handicapped individuals, will become a reality. While the use of industrial robotics has not increased as was projected three or four years ago, technology development and engineering advances are occurring which provide for greater flexibility and eventual lower costs. For example, the "Functionoid," developed by Odetics, weighs approximately 400 pounds and can lift a three-ton truck. It can also climb stairs, step over obstacles, enter and exit automobiles, and provide other functions as a skeletal mechanism support system for immobile handicapped individuals. A number of firms presently manufacture relatively low-cost robots which can be integrated into various types of instructional settings.

Summary

Technology advances are inevitable. Technology and peripheral devices developed for business and home use will affect the nature of courseware and products available for use in education. Advances in artificial intelligence and robotics for use in industry will transfer into education over the next two to four years, contributing enormously to quality courseware which will fully use the expanding capabilities of the microcomputer. The videodisc is at the state where the microcomputer will replace many of the functions of computer-assisted instruction as we know it today. The quiet, unseen revolution is occurring in telecommunications which will have the most significant implications for education. The technology is here. However, for a society so adept in developing technology, we have been inept and indeed negligent in developing the political, social, human, and organizatinal innovations to apply that technology in such a way that its benefits can be realized. This is particularly true in education and, indeed, this is our challenge.

MICROCOMPUTER USAGE IN AMERICAN SCHOOLS FOR THE DEAF
THE STATE OF THE ART

Michael Deninger
Dean, Kendall Demonstration Elementary School

We have developed several impressions at Kendall based on national surveys we have done and frequent communication we have with professionals using computers in schools serving deaf children.

1. Although professionals in our field are repeatedly advised not to purchase hardware systems before software applications are determined, we continue to buy the hardware first. In addition, the majority of schools have no formal plans for implementation of computer technology.

2. Our experience with computers in the field of deafness pretty much mirrors what is happening in the general education field.

3. Microcomputers are used in schools for the deaf at this time almost exclusively for student instruction, computer literacy, and the teaching of programming languages -- with little emphasis on administrative uses, records management, and IEPs.

4. We are entering a period when there will be a dramatic increase in the number of computers purchased for use in schools serving deaf children. A growing number of schools for the deaf are establishing operating budgets for the purchase of computer hardware and software. This is one budget item which is growing rapidly during a period of significant reductions in other areas.

5. Schools for the deaf using and purchasing microcomputers continue to report a preference for Apple equipment for student instruction, but there is an indication that schools are beginning to purchase IBM personal computers for business office functions.

6. There is very limited shared experience among schools for the deaf with regard to the use of software for instruction. For example, there are very few programs for instruction in use at a number of schools.

7. In general, the commercial software available to us does not challenge or creatively use computer technology in meaningful ways. Many programs are nothing more than "electronic page-turners," and sophisticated graphics packages are underutilized.

8. Computers are not used routinely as tools to teach or reinforce instructional objectives from the formal school curriculum. Students tend to get their computer time "down the hall", away from the classroom, using software unrelated to what is being taught by their teachers.

9. When schools do buy computers, the reasons often given are cliches such as, "It's the thing to do," or "We need to enter the computer age," or "Because we have to -- it's the wave of the future."

10. We know almost nothing about the actual effect of instructional software on the academic achievment of our students. Evaluation to this point has been limited to teacher opinions about the effectiveness and appropriateness of software.

11. Some of the best educational software programs available for use with our students utilize "gaming techniques" which actively engage children in an interactive process and call upon their sense of competition. This might be termed the "videogame spillover."

12. Teachers in our field who use instructional software with their students consistently evaluate the software they use as "good" or "excellent," while very few programs are rated "fair" or "poor."

13. Adm' istrators in our field have reported a great need for in-service training rela ed to the use of computers and have expressed greatest interest in information about instructional software, particularly software to teach language.

Hardware/Software Developments

My impressions to this point have not been reassuring or encouraging and may have engendered in you a certain sense of disappointment. That was not my intention, however sobering the impressions might have been. Microcomputers are excellent tools which, in the hands of a master teacher, can excite and reinforce learning in deaf students. They can also host electronic mail, streamline recordkeeping, and perform a number of other time-saving functions. We simply need to devise plans to apply this technology in a manner befitting its worth.

A recent national survey conducted by Market Data Retrieval (1984) polled all of the school districts in the U.S. to determine whether school systems were using microcomputers and what types of equipment were in use. Approximately 95 percent of all the school districts in the nation responded to this survey. The results indicated that some 13,152 or 86 percent of the estimated 16,000 school districts in the U.S. were using some kind of microcomputer for instruction. Of this number, 63 percent of the districts were using some Apple equipment, 32 percent Radio Shack equipment and 20 percent Commodore equipment, only 3 percent of the schools using IBM microcomputers.

This propensity toward the purchase of Apple equipment is something that analysts said would diminish, but there is evidence from this and other surveys which indicates interest in Apple is not waning -- it may even be gaining in strength. Similarly, predictions that the IBM PC would rapidly overtake the educational software market have not developed, at least at this time.

In a recent issue of InfoWord, the results of a national software search were reported (Softsearch, 1984). The three microcomputers with the most software available on the commercial market were Apple, with 6,428 programs, Tandy/Radio Shack with 5,047 programs and IBM with 4,111 programs.

However, these numbers include all kinds of software. If one considers only educational software, the numbers get much smaller. Educational software available for use with Apple equipment number 2,880 programs, those for use with Radio Shack equipment totaled 1,858, and only 283 were for use with IBM PCs. Although the report indicated that IBM had quadrupled the total number of programs available over the previous six months, it also reported 75 percent of these programs were for business applications and not educational purposes.

It is very difficult to predict what is going to happen in the industry race to become the fastest-selling and most popular microcomputer on the market. Periodically, each company presents its newest model which they maintain will become the product of the future. They argue that their operating system will become the industry standard and boast of the "tons" of software available for use with their machine -- often an inaccurate statement to say the least!

Although there is no definitive answer, the so-called "trade journals" provde some background and insight intc these issues. In a recent issue of Classroom Computer Learning, Dyrli (1984) seemed to favor those companies which made a commitment so that all new hardware systems they develop will be compatible with software developed for previous models. Commodore, for example, when it introduced the Commodore 64, abandoned users of their PET, because the 64 would not run PET software. They are soon to introduce a new microproduct which will not run any 64 software. Atari, on the other hand, has attempted to make its new models compatible with previous hardware. Apple has maintained a commitment to software previously developed from the original Apple II, to the II Plus, to the IIe, and the IIc.

It is very likely that other companies may join Texas Instruments and pull out of the microcomputer market altogether. It was reported that Atari lost over 500 million dollars last year alone. Whatever happens, it seems certain at this point that the race to the top may not be as onesided as analysts once said it would be. IF IBM does take the lion's share of the educational market, companies like Apple will certainly give them a run for their money. This does not even consider the entry on the American scene of the Japanese micros. Will we have another example of an American industry brought to its knees at the hands of Japanese ingenuity? Only time will tell, but the fact that several Japanese microcomputer companies have banded together and agreed to use the same operating system and have already secured software development contracts with American companies is important. They may become powerful competitors in the near future.

KDES Software Survey

Because little information was available to help us examine what was happening with educational software in our schools for the deaf, we undertook a survey of all of these programs. There were two reasons for conducting this survey. One was simply to determine what software was in use in our schools. The second reason was to gather information about what software is available on the market, so we could use this information to compile, print, and distribute to schools in our field a catalog of instructional software.

A simple questionnaire was designed which would reveal, among other information, what instructional software programs were in use in the schools, what equipment they ran on, how much they cost, the subjects for which they were appropriate, the grade levels, and evaluations of their effectiveness. The survey was mailed to over 640 schools and programs. Responses were received from 160 programs, representing a 25 percent rate of return. Of those responding, 49 percent or 79 different schools reported they were using some software for instruction. This represents only 12 percent of all those 640 programs polled, but, without responses from 75 percent of the schools, there was no way of telling whether these schools were representative of the whole population.

Of the 289 software package programs in use, 160 of them were in use only in residential schools, 77 programs were in use only in day schools, and 52 programs were reported to be in use at both day and residential schools. Another way of looking at these results is to say that 73 percent of all the 289 software packages were being used by residential schools, and 44 percent of all of the programs were being used by day schools. Only 52 or 17 percent of the programs were reported in use in both day and residential programs. The total number of packages reported (289) was much less than the known number available on the market.

The survey also asked on what types of hardware the software which the schools were using was designed to run. Of the 289 software programs in use, 229 of these ran only on the Apple II or IIe, representing 80 percent of those reported. Another 4 percent ran on Apple equipment and some other kind of hardware, giving Apple a full 84 percent of the software reported in this survey. The rest of the software ran on a variety of hardware systems including Commodore, Atari, Radio Shack, Texas Instruments and IBM, but none of these systems accounted for more than 5 percent of the total of 289.

The survey results were also analyzed to determine how many different software programs each of the schools had purchased and were using. Of the 79 schools that reported they were using instructional software, 73 specified how many software programs they were using. Fifty-eight of the schools reported they had between one and five software programs, four reported between 6 and 10, five between 11 and 15, four 16 and 20, and only two more than 20. Although the number of schools represented in the responses was small, there is reason to believe that, if the schools had more programs in use, they would be likely to report them. As it was, only 15 schools reported having more than five educational software programs -- a small number when one considers the number of programs commercially available.

This appears to indicate that our schools to this point, with a few exceptions, have had limited experience with the use of instructional software with students. This should not be interpreted as a great fault, since the use of software for instruction in public schools with hearing students is probably no more advanced. It might also indicate that we are not finding suitable software for use with our students among all that is available. This is also the case with the search for software in public schools.

Given the fact that the majority of our schools reporting the use of software had five programs or less, the survey results were then analyzed to determine whether the schools were using the same programs or different ones. Of the 289 programs reported in use, 200 were used in only one school and nowherw else. There were 54 cases in which two schools were using the same pair of programs. This does not mean that two schools had 54 software programs in common, but that matched pairs were found 54 times over all the responses. Similarly, matched triplicates were found 14 times. But the fact that the majority of the programs were in use in only one school reinforces the impression that our collective experience in using the same software with our students is limited.

The data were analyzed to identify which programs were in use in the largest number of schools. Twelve instructional software programs were reported in use in five or more schools. The one program used in the greatest number of schools was "Bank Street Writer", in use in 14 different schools. Three programs were from the MECC series (Minnesota Education Computing Consortium), a popular software development effort that has been sponsored for several years by the State Department of Educational in Minnesota. One program, "Blocks Authoring System," was developed at the California School for the Deaf in Fremont, and is an easy-to-use authoring system designed to let teachers program their own lessons. Another very popular program was Logo, which can be used with very young children and does not require reading skills. Only one of the programs was designed for use with social studies instruction. No programs in science were in use in five or more schools. This is consistent with the experience with nonhandicapped students as well. Many more commercial programs are available in math and language than in social studies or science.

This math and science void was also supported by our own survey results. Of all of the programs reported in use, 39 percent were reported to be for use in language instruction and 42 percent in math. Only 10 percent were reported in use in science, and only nine percent in social studies. This lack of software in these two subject areas has been relatively the same for several years now.

The survey data were also analyzed to try to determine the cost of software programs in use. Of the 231 programs for which software costs were ported, 159 or 69 percent cost $50 or less. Fourteen percent of the programs cost $51 to $100, nine percent $101 to $200, and another nine percent $201 or more. In general, the more expensive programs were more than just a simple 20 or 30 minute program. Some of them were a whole series of instruction in a content area, e.g. the Millikin Math Series.

Other results derived from analysis of the survey data paralleled those which are reported in the literature about the current status of software used with hearing students. For example, few software programs were reported which would be appropriate for use with preschool students. The exception to this was "Logo." In addition, software reported appropriate for primary age students was also reported appropriate for use with junior high or high school students. This could reflect the teacher's ability to use software in a number of different ways, a desire to use whatever software is available regardless of its real appropriateness, or it may reflect the wide range in student achievement levels we find in our schools.

The survey also asked respondents to evaluate each of the programs in use by rating each excellent, good, fair, or poor, based on student or teacher feedback. A few of the programs were rated very high and tended to be the ones which were being used in the greater number of schools. The results indicate that software programs, as a whole, were rated suspiciously high. Thirty-nine percent of the time programs were rated as excellent, 45 percent of the time as good, 13 percent of the time as fair, and only three percent of the time as poor. This in inconsistent with most reports about software available on the market. Professionals who are involved in the evaluation of software in a systematic and formal fashion almost report that the vast majority of software available on the market has little value. Our respondents may have evaluated their software highly because they did not have much information about the capabilities of good software, because it was all they had seen, or because they were enamored with the idea of using the computer with students. Whatever the reasons, the evaluation data collected from our survey is very inconsistent with others which have been conducted and should be examined with great care.

KDES Software Selection Process

For the past year, KDES has been attempting to identify, preview, and purchase potential software for use with our students. Early in this process, we decided that we would not purchase any software which we had not already previewed and tested on our computers. We also decided not to purchase any software unless it could be used for some specific instructional purpose. This meant we would not purchase any software unless it could be matched to objectives in our formal school curriculum. Our curriculum resource teachers in math, science, social studies and language arts were given the assignment of developing a simple evaluation instrument which we would use for all software evaluations, so we could keep a record of this work. The steps in this process were as follows:

1. Identify appropriate software catalogs;
2. Order software catalogs;
3. Review catalog descriptions of software;
4. Request preview of software (either at school using the mail, or at a local computer store);
5. Preview software, matching it to curriculum objectives;
6. Purchase acceptable software.

We believe this was a wise decision. Of 391 catalog descriptions of software reviewed, only about one-half or 207 were requested for preview. Of that total, only 25 or about six percent were found to match objectives in our curriculum. More than half of those 25 were then rejected because they were not consistent with the philosophy of one of our subject areas. This left 11 programs -- only three percent of the 391 catalog descriptions we originally reviewed. This may seem like a hopeless cause, but we have continued the preview process and are identifying software slowly but surely, which is consistent with our approach and which we feel will have real instructional relevance for our students. The alternative, to purchase software without thought or care, would waste time, energy and money.

Summary

We are still in the infant stages of finding and realizing systematic and effective applications of software for instruction that makes a difference in terms of student achievement. In fact, this should be the bench mark against which we measure the success of any instructional intervention. Computers must stop being an end unto themselves and begin finding their rightful and appropriate place in the education of our students. Careful planning can accomplish just that. We need to "pool" our collective experience and realize tht we are in no worse shape than the public schools -- probably in much better shape! There is no reason why we, as educators of the deaf, cannot lead the field of education with new computer innovations as we have led the field of education with other innovations in the past.

MANAGEMENT AND COMPUTERS

Phil Mackall
Kendall Demonstration Elementary School

The use of computers in management usually evokes a picture of a researcher or administrator entering large data bases into a computer and asking the computer to sort that information to produce lists, statistical test results, and graphic displays. A more modern scenario would include a broader picture: the computer as a tool to manage data, produce written documents, communicate with colleagues. Let's take a look at that more modern picture as it functions at Kendall School.

Kendall Demonstration Elementary School in Washington, D.C., currently (1983-84) has 13 Apple IIe and two IBM PC microcomputers attached to two Corvus 20 MegaByte hard disks via Corvus Omninet. The micros are located throughout the school so that they are easily accessible to all faculty and staff. To provide the "management" capabilities, five packages are used: (1) a curriculum management system (CMS); (2) an individualized planning system (IPS); (3) an administrative planning system (APS); (4) a word processing package; and (5) an electronic mail package. In addition, there are three Apple IIe microcomputers for student use that are not connected to the network.

Developing, Implementing, and Managing Curriculum

Kendall's curriculum guides have been entered into the computer using the curriculum management system. The guides list goals and objectives and a variety of other information that will facilitate instruction of each objective. The "other information" varies from guide to guide because of the content needs of the curriculum area, but generally includes: suggested vocabulary, activities, materials (text books, film strips, manipulatives, computer software, etc.), and testing procedures.

All information that has been entered can be revised whenever desired. Thus, the list of activities, materials, etc., can be updated as new activities are created or new materials are purchased that are appropriate for a given objective. Since the computerized curriculum is stored on the hard disk, teachers can access it at any connected terminal to find the newest ideas to teach the objectives.

Producing IEPs

Information on students, normally stored on reams of paper and placed in a central folder, has been entered into the instructional planning system. This information includes demographic data, medical data, educational history, class placement, current objectives, special referrals, etc. Using the data from the instructional planning system, a total of eight standard reports can be quickly generated. One of these reports is the IEP (Individualized Education Plan) as required by P.L. 94-142. In the past, production of the IEP required re-entering old information on a new sheet, adding updated information where necessary, selecting objectives for the new year, transferring the objectives to the IEP form (by typing the new objectives or by xeroxing pages from the

Accessing Student Information

When student information (telephone numbers, results of audiological tests, SATHI scores, etc.) was needed in pre-computer days, teachers had to thumb through files to find the information. If the information could not be found, a call had to be placed to the appropriate person to see if the data were missing or if it had never been acquired. Missing documents had to be sent through the mail system or picked up in person to be inserted into the file. If new information (e.g., a telephone number) had been discovered by one person, the change had to be transmitted to other school personnel by memo or in the "Daily Bulletin."

With computerization, information is stored on the hard disk which can be accessed by all parties from the nearest computer. Thus, updating of information can be accomplished without paper and pencil and is available not only to the requesting party but to all others who may need the information later. Also, if the person supplying the data cannot be reached by phone, a message can be left on the electronic mail system; the supplier can respond when possible.

Tracking Special Services

Tracking special services requested (e.g., psychological counseling, vision testing, social work services) traditionally has required recording information in several places so that it would be available to the teacher requesting services, to the teacher's supervisor, to the specialist providing the services, and to the specialist's supervisor. This often resulted in inaccurate or incomplete information in one or more places.

Use of the IPS an APS makes it possible for easy centralization of the total referral process (referral request, service provision, and completion of service reports). It also makes it simple: (1) for the teacher to check on students in his/her class for whom requested services have not yet been provided, (2) for a departmental supervisor to get a listing of students in his/her department who are/are not receiving services, (3) for a specialist to get a listing of all students requiring his/her services, and (4) for the specialist's supervisor to access information on each specialist's work load.

Creating Worksheets, Reports, Letters

The production of worksheets on dittos has been notoriously time-consuming, especially when mistakes are made while writing or typing on the ditto. A word processing program makes creating these same dittos easy and quick. The ditto is never inserted in the typewriter until the worksheet is perfected; different-sized typing elements can be used to make the same ditto appropriate for students with different visual abilities. Similar worksheets can be made rapidly by copying a file and changing only the information that is different.

curriculum and checking appropriate objectives), and making three copies of the total document -- a very time-consuming process. Using the computer, old information is updated during the year; objectives are transferred from the computerized curriculum library to the student's file (approximately 6 to 15 keystrokes per objective), and a clean IEP is printed on three-sheet sensitized paper with a minimum of effort (a few more keystrokes).

Processing Intakes

New students at Kendall go through an intake process that involves interviews and examinations with several professionals. In the past, each person has had a separate form that often duplicated information such as name, date of birth, phone number, parents' names. Using the computer with the individualized planning system software during the interview/examination to store student information means that the parent needs to give this information only once. When a second or third person is ready to perform part of the intake process, that person will find the basic information already entered and can proceed with the specialized data pertinent to his/her field. Individual printouts for each part of the intake process will contain the basic information and the specialized information.

Planning Daily Lessons

Using information from both the individualized planning system (IPS) and the curriculum management system (CMS), the teacher can plan lessons more easily and efficiently for students using up-to-date information. The IPS provides a list of objectives that are appropriate for each student in the class; the CMS provides the most current list of instructional strategies (activities) and materials for teaching each objective. In the past, the information in the curriculum guides was at least a year old since cost in time and paper prohibited revision and reprinting more frequently than every few years. Now with student and curriculum data stored on the hard disk, access to this information is available throughout the school on any networked computer; thus, no heavy curriculum guides and student files to carry around.

In the past, scheduling students has required going through files manually to gather data on each student regarding test scores and other pertinent areas to help the teachers and supervisors decide on placement for the next year. Student names were then sorted and resorted to try to achieve the best class placement. Once that was completed class schedules were typed by a secretary. Any changes during the year required re-typing the whole schedule.

Using the IPS and APS (administrative planning system), testing scores and other data can be pulled by the computer and sorted in various ways to indicate possible appropriate class placement. A task that required hours in the past can now be accomplished in a few minutes. Class schedules can be recorded in the IPS and printed out as needed; changes in the schedule require changing only the pertinent parts and asking the computer to reprint.

Creating Form Letters, Documents, Labels

First there was: write your report or letter by hand; give it to a secretary for typing; proof it and send it back for corrections (which often meant retyping the whole document). Form letters are xeroxed and look like form letters; they take a day or two for the process depending on how busy the secretary is.

Then, there was: write your report or letter by hand or type it; give it to word processing; resubmit it two or three times for corrections. Form letters can be personalized, but you hear complaints if you need a large number of letters since word processing serves many people; it takes a week to complete the process since you walk it through or send the documents through the mail.

Now there is: write your report or letter by hand or type it yourself on the computer; ask your secretary to type it on the computer (if you didn't do it already); print it out or transfer it to the hard disk for printing (if you can wait a day to get it); proof the document and make corrections yourself or ask the secretary to make corrections (it will never have to be completely re-typed unless you trashed the original and started over). Form letters will be personalized; the process can take from a few minutes (if you do it yourself and the document is short) to a day or two. In addition, creating labels or typing envelopes can also be an easy task using the word processing package.

Communicating "In-House" and "Out-House"

How many times have you tried to contact co-workers by phone or in person only to find they are not in? You don't want to dictate a long message to the secretary (who probably wouldn't let you anyway), so you leave a message for the co-worker to call you back. A game of hide and seek is the next scenario with both of you just missing each other.

Electronic mail provides an easy medium for communication. Try the phone first; if it doesn't work, leave a message on the computer which the other person can read when returning to the office and reply to you on the phone (gathering pertinent data first) or via the mail. In addition, electronic bulletin boards are available which can be used for sharing or gathering information of interest to the general population. Because Kendall's system is capable of telecommunications, this sharing of information can be done "in house" (at Kendall) or "out house" (with other professionals around the country). The mail and bulletin boards will also be used by students for student-to-student communication.

Generating Reports

Administrators and researchers are frequent users of statistical packages to gather and analyze data for reports. This usually required entering new data every time a new report was requested. Using the APS to manipulate data from the IPS or to enter new data, teachers, researchers, and administrators can sort data on individual students, on a small group of students, or on the total student population. Standard reports such as attendance for LEAs, test results for Congressional presentations, department class lists by teachers, etc., can be programmed once; data is automatically fed to the APS from the IPS when the data is entered or changed; reports can be accessed at any time by merely asking for the sort. Nonstandard reports can also be created on as as-needed basis. Simple statistical packages and graph-producing software are also attached to the APS for easy reporting.

Helping Students Manage

Adults are not the only persons who can benefit from managing their activities on a computer. Students, too, can increase productivity. Some examples: (1) a report for social studies can be typed on a word processing package (like "Bank Street Writer") for easy correction after the teacher has evaluated it; (2) stories with multiple endings can be generated in a language class using an authoring system; (3) data gathered for a science experiment can be analyzed using a database management system; (4) students can use the electronic mail system to communicate with other students around the country (this is a great language motivator).

Summary

These are just a few of the ways in which computers can help manage the daily tasks of a school. Most of them are currently happening at Kendall. Others will develop as our knowledge of today's technology increases and as the technology itself grows. The software and hardware needed to accomplish the daily tasks vary, as do the needs of individual educational programs; therefore, each school should assess its own needs as it, too, learns to use computer management in reducing time and paper while increasing efficiency and productivity of faculty, staff, and students.

THE COMPUTER AS AN IEP RESOURCE

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New York School for the Deaf

When an educator discusses special education, the concept of the IEP automatically becomes a part of the discussion. Under the provision of the Education for All Handicapped Children Act of 1975 (P.L. 94-142), each handicapped child must have a document prepared which provides information about the child and the goals and objectives for educational services. This document is the Individualized Education Plan (IEP).

Most people now recognize the IEP as an eduction plan to meet the unique and special needs of the individual student. These plans have been developed and written by individual teachers and administrators, along with parents and other support personnel, and have taken on a variety of formats, styles, and techniques. Most people have seen the preparation as very time-consuming, and at best, an inconclusive document of what actually is and shall be. One reason for this feeling is that it is difficult for a person to generate all of the information to cover the various field of endeavors, the various objectives and goals, and to develop other such statements that will provide a comprehensive view of what the child is doing and will be doing for a period of time. The use of current technology, specifically the microcomputer, can be of great value in overcoming many of these difficulties.

The concept of utilizing computers for the development of the IEP is not new. Since the inception of the IEP, many people have suggested that the procedures be computerized for more efficient preparation. However, complaints were also received that computerization of the IEP would be limited since the materials would not be individualized or specifically prepared for an individual child. It would appear, however, that the mandate or intent of the law does not require that all goals be worded differently for each child. Likewise, the wording of the law does not prohibit the sharing of the same goals by several students. The IEP goals and objectives need not be so exact and specific that there is no room for variations, either. The law does require that the information contained in the plan be fitting and appropriate for the individual for whom it is prepared. The strategies of instruction must be educationally sound both in concept and in preparation. The information must be communicated in a manner that is understood by all who read the document. The preparation of the IEP appears to be suited for utilization of today's technology.

The computer can best be described as an information management tool. The computer serves the same functions as the file cabinets in the school, a report writer, a collator, an information searcher, and so forth, all in one. This is not to say that the computer does not need the human touch. Rather, it must be emphasized that information must be entered by the human after it is prepared by humans. The computer serves as an instrument for the storage, sorting, and retrieval of information.

Phase I of IEP

The Individualized Education Plan is divided into two parts -- known as Phase I and Phase II. Phase I of the IEP contains the information which describes the student and the program which is appropriate. The information includes, but is not limited to: student demographics; student medical records; review dates and clinical assessment records; related services; record of academic evaluation; student management needs; and information on student mainstreaming.

The IEP system utilized at the New York School for the Deaf is the Ex-Ed Student Information Management System. The key concept for this system is "student information management." Information is entered in the computer and stored therein. The records can be modified, updated, sorted, and printed with ease by the computer. The data can be readily accessed, reviewed, and researched. Information can be retrieved in part or in full according to a variety of subject headings. Information can be retrieved for all students, for one student, or for a group of students. Information can be sorted, batched, and retrieved according to specific criteria such as age, class, teacher, review dates, evaluation dates, home school district, achievement level, handicapping condition, or any combination of these.

For purposes of computerization, each section of the IEP for data entry is referred to as a "screen." Student demographics (placement records) is Screen I of the Phase I IEP. This information includes the name of the student, family information, ethnic status, type of placement, school, class and teacher placement, termination dates, and information on amount of regular educational program. The students, may be grouped according to any of the parameters listed.

Screen II provides information on the physical development of the child and provides for special medical alerts. Medical information can be tracked utilizing this Screen.

Screen III provides information on the dates of clinical assessments and other evaluations. Dates of the evaluation can be used to select students who need a certain type of assessment and evaluation at specific times.

The related services portion of Phase I are listed on the Screen IV. This document provides information about the related services necessary for the student. Included in this listing are transportation, audiological services, psychological/social services, occupational therapy, physical therapy, recreational needs, speech pathology, heart therapy, dance and movement therapy, and adapted physical education. The computer stores, searches, and prints out the areas of related services by provider, initiation date, termination date, or any combination.

Screen V presents the levels of performance on tests that measure achievement. The primary tests used at the New York School for the Deaf are the Stanford Diagnostic Tests in math and in reading and the Stanford Achievement Test. Other tests can be reported here also.

One of the most comprehensive areas of Phase I is the social/behavioral management needs and the educational management needs section. This is found on Screen VI of the Ex-Ed Computer Management Sysem. The suggested educational management needs and the suggested social/emotional management needs can be selected from a comprehensive list of statements and identified by number. These numbers are entered into the computer for storage and later printing. Areas are also provided on this Screen for statements of intellectual functioning, academic skills and weaknesses, an social and emotional skills and weaknesses. These must be prepared in writing for the computer data person to enter.

Screen VII provides information about the subjects and grade levels of mainstreaming. Students who attend advanced Occupational Education Programs at the local Board of Cooperative Educational Services (BOCES) from the New York School for the Deaf are considered to be in mainstreamed programs.

The above information when stored in the computer provides the possibility for a variety of searches and cross references. The computer stores a great amount of information, sorts it, changes it with ease, and retrieves and prints it upon command. All of this represents the primary facet of the computer as a management tool for information for the Phase I of the IEP.

Storing Behavioral Objectives

The computer as a storage and retrieval system also represents a consistent expressive tool. The computer can sort thousands of statements which can be identified by code number for later retrieval. Thus, thousands of behavioral objectives worded in proper formats within specific topic areas and in developmental sequences can be prepared and stored on the computer. These thousands of statements then become the source of the individualized goal and objective statements.

In the Ex-Ed System, approximately 8,000 goals and objectives in various curriculum areas are stored. The core of the system is the I.B.A.S., the Instructional Base Appraisal System, developed by Dr. Edward Meyen of the University of Kansas. These materials have been tested in school districts throughout the country since 1977 and are regarded as one of the best tools of their kind for instructional planning and management.

The IBAS Objective Cluster Banks are in seven volumes: Volume 1, mildly handicapped; Volume 2, severely and profoundly retarded; Volume 3, career education; Volume 4, prevocational skills; Volume 5, physical education; Volume 6, science; and Volume 7, language. The seven volumes cover objectives in reading, math, social behavior, motor skill development, self-help, social, vocational and self-help language, work, leisure, resources, job acquisition, advanced motor skills, games, physical science, earth science, life science, comprehension, morphology, semantics, syntax, and so forth.

The IBAS Objective Base did not cover all of the necessary areas. Consequently, ExEd Objective Cluster Banks have been added in the following areas: compositional writing skills, mathematics, U.S. history 1 and 2, world and regional studies 1 and 2, computer literacy, industrial arts, typing and bookkeeping, home economics, fine arts, art counseling, travel training, life skills, health education, and career education and distributive education. Additional programs can be developed and added at any time.

From this vast bank of goals and objectives, the teacher can scan a subject/topical area and identify the goals which are believed to be important and proper for each child. The teacher then refers to the section of the manual which has the sub-objectives for the goals, reads these individual behavioral objectives, and selects by number those objectives which are believed to be proper for each child. By listing these objectives by number, the teacher's task is greatly reduced from a time-consuming writing task to a selection process. The teacher must still provide the statements of present level, materials and activity listings, and criteria level. The computer operator then enters into the computer the objective code numbers and the prepared statements from the teacher. The computer stores the information and/or prints the information onto hard copy.

One of the important concepts to remember is that once the statements are entered into a correct format into the computer, they will be retrieved and printed in a correct format. This correctness of expression includes both the language of the statements and the spelling. Also, the system and statements can be updated by modifying or adding new information at any time.

The computer serves a very important function in the development of the IEPs at the New York School for the Deaf. It stores the necessary demographic and other information on each student and provides an easy system for sorting the information for class placement, report filing, groupings, and general recordkeeping. The computer also serves as the primary source of preparation of the Phase II of the IEP document, providing in a clear and consistent fashion statements of goals and objectives which have been previously considered to be worded properly and appropriate for use.

The computer is an awesome tool for preparation of the IEP. As teachers and administrators become more familiar with its potential, more and more specific demands will be made on this technology which is available to assist us in providing better educational services to our handicapped students.

MICROCOMPUTER SOFTWARE/COURSEWARE EVALUATION

Robert D. Storm
Clarke School for the Deaf

Software Sources

This is a "can't tell the forest from the trees" issue. There are numerous sources available, and the task soon becomes that of locating the best sources. Following is a suggested list of software sources.

- Textbook publishers -- they might offer good educational software that should closely parallel textbook series used in schools and thereby fit into the established curriculum with a minimum of modification.

- Educational supply companies -- these are companies which stock a software libarary and allow for courseware preview at their various company sites. Often they have supportive staff who can also provide helpful advice.

- Computer software companies -- these are probably the best known, most advertised sources for computer software. Out of the hundreds of companies, the field can be narrowed down quickly to twenty-five or less primary sources. (Among these, I would strongly recommend looking at DLM, Hartley, The Learning Company, MECC, Scholastic, and Spinnaker, to name just a few.)

- Regional resources centers -- various states have developed a regional network of resource centers which include microcomputer software that can be previewed.

- Additional sources might include computer hardware companies, local retail computer stores, public domain software, computer clubs, local educational programs (elementary, junior high, and high school), friends, colleagues, parents and students.

Strategies for Deciding What Software to Buy

Here are some suggested ways which might help in the decision-making process on how to select microcomputer software.

- Find and read software review journals. One that I particularly like is published by EPIE (Educational Products Information Exchange) and Consumers Union. This is a nonprofit consumer organization which includes 30 national organizations and more than 100 professionals, all of whom are part of the review process.

- Read magazine articles that evaluate and/or describe software. Be sure to note if these reviews are composite opinions (which I feel are more reliable than a one-person critique). I particularly like Scholastic's "Electronic Learning," Classroom Computer Learning," and "Creative Computing."

- Various computer magazines offer an annual directory which is an extensive compilation of suggested software and microcomputer-related resources. Several that I would recommend are published by "Instructor Magazine," "Classroom Computer Learning," and "Classroom Computer News."

- Brochures and catalogs from vendors/software companies can be helpful for giving details about software, but the consumer needs to realize that the vendor may hold a biased view of the product and will not necessarily indicate any shortcomings of the software.

  Note: Be sure to preview the software before purchasing it. Most reputable companies will allow a 30-day preview period with several possible stipulations, some of which include a purchase order number, return for credit only, or possible return for a refund. I have also found that personal contact and a straightforward approach seem to produce the best results. Remember, <u>you need to see it and use it before buying it.</u>

<u>Questions to Ask When Selecting and Evaluating Software</u>

It is important to consider all of the eight points given below. However, the most important question is, "Does the content have educational value?" As educators, we must constantly guard against simply getting caught up in flashy graphics or clever simulations to the point of ignoring the educational purpose that the software serves.

1. Is the program easy to run?

   a. Does it provide instructions on the computer screen and in the operator's manual?
   b. Can the operator control the speed of the program?
   c. Does the program allow for errors?

2. Is the program design flexible?
   a. Does it branch into new materials?
   b. Does it allow for review?

3. Is the reading level appropriate and does it use text effectively?

4. Are graphics employed directly and appropriately?

   a. Do graphics distract from the program?
   b. Do graphics relate to subject?
   c. Do graphics appropriately reinforce correct answers?
   d. Do graphics inappropriately reinforce incorrect answers?

5. Does the program include a "menu?" (A menu is a listing of the parts of a lesson or program, similar to a topic outline.)

   a. Does the program begin with a master menu?
   b. Does it contain sub-menus that allow the user to return to the master menu at any point?

6. Is the program content accurate and well-designed?

   a. Is the program free of content errors and misspellings?
   b. Are activities appropriate for age level?
   c. Does the content have educational value?

7. Does the program offer a complete learning package?

   a. Does it have clearly-written, detailed documentation?
   b. Does it include teacher directions, descriptions of program content, learning objectives, and age level for which the program was written?
   c. Does it include followup activities and references?

8. Is there a program purchase warranty?

   a. Does the publisher offer a backup disk or do copyright laws allow you to make one?
   b. Are disks covered by at least a 90-day warranty?

Who's in Charge Here?

Clarke School established a planning committee during the 1981-82 school year composed of four teachers representing each of the three academic departments at the school. They met for five weeks during the summer of 1982. Numerous recommendaitons were made, and the committee established both short- and long-range goals for the establishment and use of microcomputers at Clarke.

Subsequently, two members of that committee served as coordinators of the microcomputer project during the 1983-84 academic year, and this type of arrangement is expected to continue.

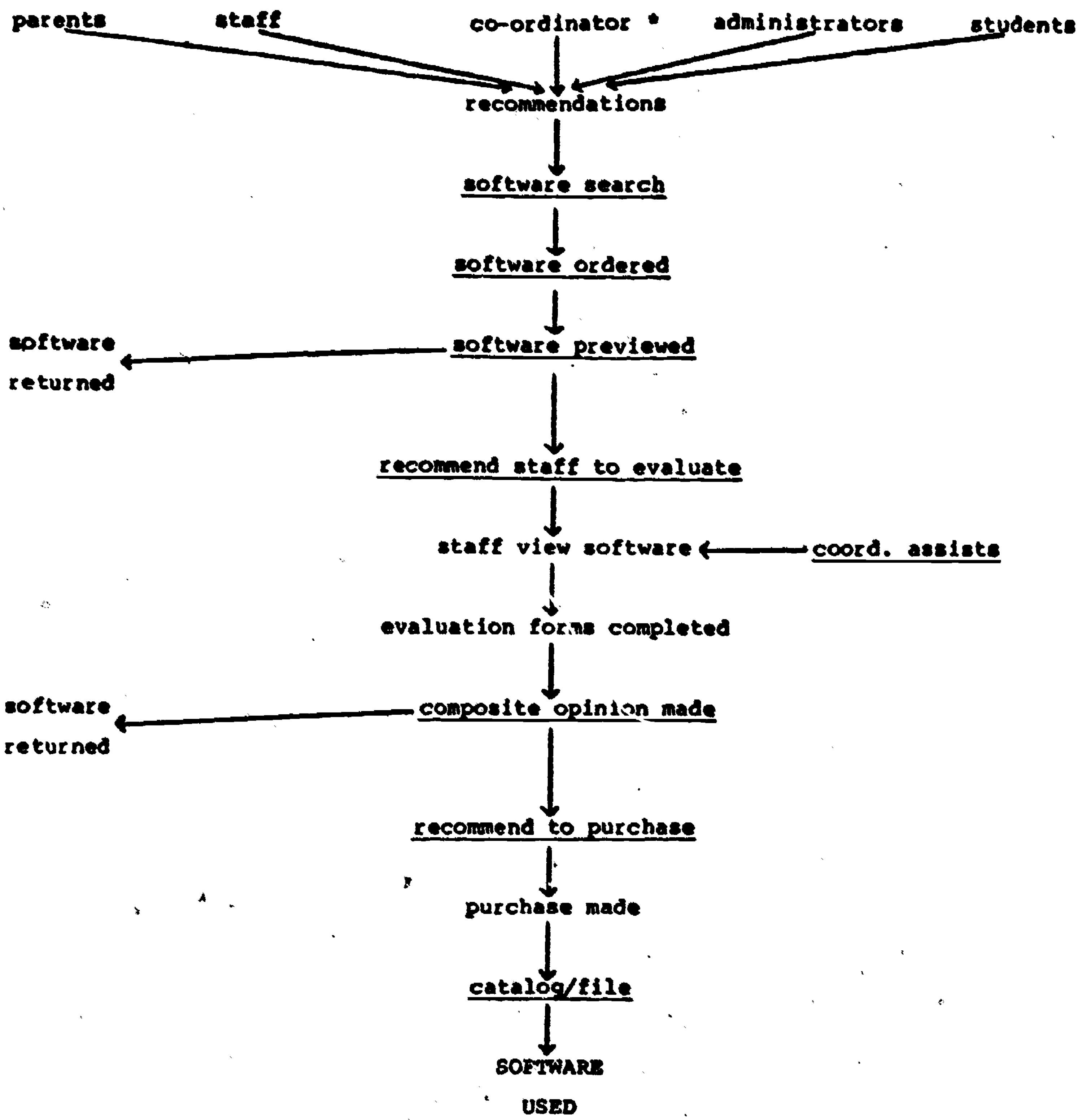
It is very important that leadership be clearly established and responsibilities delegated to an appropriate staff member (or members) for the most effective implementation of microcomputers into an educational program. At the same time, it is necessary and advantageous to involve as many members of the staff as possible in the process of software evaluation.

First, a coordinator cannot know if a staff member would or would not use a specific piece of computer software in his or her class.

Second, by directly involving members of the teaching staff in the evaluation process, two major purposes can be served: additional hands-on experience with the microcomputer is provided; and, having worked directly with a given piece of software, the teachers are more likely to use it with their students.

The entire selection and evaluation process needs to be outlined clearly and followed carefully to avoid confusion and waste of time and money. Figure 1 is a schematic diagram of the software review process that has been established at Clarke School.

Figure 1.



*The underlined sections indicate the primary responsibility of the co-ordinator.

Software Evaluation and Forms

Each software program should be evaluated on a standardized form that best meets the requirements of the educational institution in which it is to be used. Clark School developed its evaluation form based on reviewing formats used in other settings. This form provides for more easily categorized inputs through the use of checklists, with space provided for comments after each item and at the end of the form.

Besides assisting in the recommendation process, these completed forms also act as a data base which can be easily referred to for various purposes, including checking to see what software has been evaluated, by whom, when, etc.

Conclusion

Where's the beef? The "beef" is in the software. If it is the "right stuff," both staff and students will be excited when using it; they will use it, and it will help. It should provide the necessary practice so often required by hearing-impaired students; it will be motivational; it will help students apply what they have learned; and it will assist the teacher in individualizing class work which is often so difficult to achieve.

The availability and use of microcomputers and related software needs to be made as easily as possible, especially when a program is just getting underway and positive attitudes are being cultivated. If there is a real curriculuar need, and appropriate software has been purchased, then the microcomputer should be able to help meet that need.

Initially, teachers learned how to operate other equipment such as overhead projectors and filmstrip projectors; then they learned how to use them effectively. So teachers must first learn how to operate a microcomputer and its software, then learn how to use them effectively.

Many of us may have had firsthand carpentry experience. The right tools helped us build shelves faster and better, especially if the right tools were in the hands of a skilled person.

The right computer software has the potential to build those important concepts, provide those necessary experiences, give that needed practice, and improve the motivation of our hearing-impaired students.

But tools do not build shelves by themselves, nor do micorcomputers make better or smarter students. The best tools for these jobs must be chosen carefully and then put into the hands of skilled administrators and teachers.

EVALUATION OF SOFTWARE

Name of Program ______________________ Name of Evaluator ______________________

Level ______________ Price ______________ Date ______________

		T	t	f	F	n.a.	* Comments
C O	The content is appropriate. (Language level, vocabulary, reading level)						
N	The content is well organized.						
T	The content has educational value.						
E	The content is motivational.						
N T	The text follows established rules of grammar, punctuation, capitalization, and usage.						

		T	t	f	F	n.a.	* Comments
I	Presentation of material is clear and logical.						
N	Examples are provided with directions when appropriate.						
S	Level of difficulty is appropriate.						
T	It provides for individual needs.						
R U	Graphics/color are used for appropriate instructional reasons.						
C	Program utilizes upper/lower case.						
T	Feedback on student responses is effectively employed.						
I	Students are given more than one chance to answer.						
O	Feedback is immediate.						
N	The student controls the rate of the program.						
A	Program uses branching for further concept development.						
L							
Q							
U							
A							
L							
I							
T							
Y							

*T = true <u>all</u> or <u>most</u> of the time
t = true <u>some</u> of the time
f = <u>not</u> a good description
F = <u>never</u> or <u>almost never</u>
n.a. = <u>does not</u> apply, cannot rate

page 1 of 2

		T	t	f	F	n.a.	Comments
T	The teacher's manual is easy to follow and useful.						
E	The display format is effective.						
C	The size of print is appropriate.						
H	The screen display is well organized.						
N	It is visually interesting.						
I	The amount of material on each frame is appropriate.						
C	The length of each section is appropriate.						
A	The program allows for adaptability by the teacher.						
L	The teacher may edit or change a program.						
	The program is easy to operate from start to finish.						
Q	The student can operate the program independently.						
U							
A							
L							
I							
T							
Y							

Additional Comments: (Strengths and weaknesses)

___ I would use or recommend use of this package with little or no change.

___ I would use or recommend use of this package only if certain changes were made.

___ I would not use or recommend this package.

0005Q

SOFTWARE EVALUATION

Marilyn L. Jost
California School for the Deaf

The use of computers in the educational setting has progressed at such a rapid rate that many educators are unprepared to meet the high-tech challenge adequately. In the rush to keep pace with the educational computer evolution, many educators are bypassing the necessary steps in planning computer use strategies in their schools. It must be remembered that computers are not a quick-fix device or a panacea for the educational ills that face the schools today. A computer is only one of many tools that the educator can utilize to help correct academic deficiencies. Only through developing a needs assessment, planning carefully to meet those needs, and selecting appropriate software and hardware will one be able to use computers as one of many sources to close educational gaps.

Completing a Needs Assessment

In order to select software appropriate for student use, an assessment must be completed to determine specific needs. This assessment can be developed using results from formal testing instruments in the areas of language, reading, math, and cognitive developmental levels. Information evaluations and teacher interviews can also be utilized. A cost-effective program can then be developed to consider the scope of the student population needs and to focus on specific academic areas, cognitive levels, chronological areas, and special needs students. The results of this assessment can then be coordinated with the purchase of available software programs as they relate to the curriculum.

When the needs assessment and the search for available software appropriate for targeted skills, cognitive levels and ages have been completed, decisions as to long- and short-range goals can be finalized.

It is suggested that the development and implementation of these goals extend over at least three years, if all uses of the computer such as CAI, programming, and word processing are to be incorporated. This is not to say that all uses of the computer must be utilized. This decision is dependent on the students' needs. However, the present trend of computer use is to utilize the computer as a tool and develop thinking skills. This time frame would allow adequate time for teacher training and procurement of additional hardware and software. A solid, well-rounded computer program requires time to develop.

Establishing Goals

In establishing the long- and short-range goals for the computer program, it must be determined how the computers will be utilized for maximum effectiveness in terms of the students' cognitive developmental levels and their abilities to use the various types of software. Table 1 shows the relationship between developmental levels and computer software and other uses.

Computer assisted instruction (CAI), includes software designed for drill and practice, tutorial, simulations and educational game purposes. All four types of programs are contingent on the idea that the computer controls the student and the learning process. Other uses of the computer such as computer literacy, programming, and word processing allow the students to control the computer. The students have full control of the learning process. Thinking skills play an integral role in this area of computer usage.

A software evaluation form must be developed to assist the educator in previewing, selecting, and purchasing software. This critical evaluation of software will ensure the purchase of well-designed programs that are related to the school's curriculum, that are technically sound and effective in motivating the learner, and that meet the needs of the students. Figure 1 shows a suggested software evaluation form.

A well-designed computer program depends on planning, evaluation, and adaptation. Yearly evaluations should be made of the program's goals and how well the computer program meets those goals in terms of students' needs and progress.

Computer technology is here to stay. How we as educators utilize this technology to its fullest potential depends solely on the ability to plan a cost-effective program, incorporating well-designed software that meets the goals, needs, and interests of the students.

Following is an outline of activities for selection, evaluation, and purchase of software.

Table 1. The Relationship Between Developmental Levels and Computer Software and Uses

Preoperational: Preconceptual thought 2-4 years	Preoperational: Intuitive thought 4-7 years	Concrete 7-11 years	Formal 11 + years
CAI - The computer controls the student.			
	Drill and practice	Drill and practice	Drill and practice
		Beginning tutorial 10-11 years	Tutorial
		Simulations using concrete experiences 10-11 years	Simulations using hypothetical situations
	Educational games	Educational games	Educational games
The student controls the computer.			
	Computer awareness + literacy	Computer awareness + literacy	Computer awareness + literacy
	Big Trak	Big Trak	Big Trak
	LOGO	LOGO	LOGO
		Simple programming and problem solving	Programming and problem solving
		Word processing	Word processing

42

Figure 1

I. Suggested Software Evaluation Form

Name of program____________________ Company____________________

Subject/concept____________________ Evaluator____________________

Grade Level (s): K 1 2 3 4 5 6 7 8 9 10 11 12

Developmental levels: Preoperational Concrete Formal

Scope:

___ single concept program
___ program is one part of a larger instructional unit
___ complete instructional unit

Type of Program:

___ drill and practice
___ tutorial
___ simulation
___ problem solving/logic
___ educational games
___ other ____________________

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Documentation:

Does it have:
___ documentation?
___ stated prerequisite skills?
___ program operating instructions?
___ Is it easy to follow?

Brief Description of the Program:

Objectives: ____________________

Prerequisite skills/language of direction/vocabulary: ____________________

Strengths/weaknesses: ____________________

Reinforcement/follow up activities: ____________________

Comments: ____________________

YES	NO	N/A	CHECK THE APPROPRIATE SPACE.
			<u>Instructions:</u> (available in program)
___	___	___	1. Can user skip them and return to them as needed?
___	___	___	2. Is the user told how to end program? start over? re-enter where user left?
___	___	___	3. Can user control speed?
___	___	___	4. Is there a menu to allow user to access specific parts of the program?
			<u>Input:</u>
___	___	___	1. Can user correct input if necessary before continuing program?
___	___	___	2. Is there a cursor or other indicator to show where input is to go?
___	___	___	3. Does the computer give a helpful response to input errors?
___	___	___	4. Is the amount of typing required appropriate to the grade level?
___	___	___	5. Can teacher add/delete information?
			<u>Output:</u>
___	___	___	1. Are punctuation, grammar and spelling correct?
___	___	___	2. Is the correct answer, or appropriate help given after a reasonable time or after a given number of errors?
___	___	___	3. Does the program branch to easier or harder material in response to user input?
___	___	___	4. Are responses to errors nonjudgmental, free of harsh or demeaning comments?
___	___	___	5. Is the positive feedback for correct responses more interesting/enjoyable than the response to error/failure?
___	___	___	6. Does the program use motivational devices effectively?
			Check the items that are most effective:
			___timing ___ scoring ___ game format ___color
			___ personalization ___ graphics for reward
___	___	___	7. Can sound reinforcement be deleted?

YES	NO	N/A	Scoring:
___	___	___	1. Does it give number of correct responses?
___	___	___	2. Does it give number of incorrect responses?
___	___	___	3. Does it list problems that gave student problems?
___	___	___	4. Does it give percentage of problems right?
___	___	___	5. Does it give number of attempts?

Rate by circling the number which best describes the program.

Comment on back of page.	Poor			Excellent
1. Is this an effective/appropriate use of the computer?	1	2	3	4
2. Are the objectives/purposes of the program well defined?	1	2	3	4
3. Does the program achieve its objectives/ purpose?	1	2	3	4
4. Is the program technically sound, free of programming errors?	1	2	3	4
5. Is the content factually correct?	1	2	3	4
6. Is the presentation logical, organized and consistent?	1	2	3	4
7. Are the interest level, difficulty level and vocabulary level compatible?	1	2	3	4
8. Are the instructions clear, complete and concise? Comment: ______________	1	2	3	4
9 Is the screen format neat and uncluttered?	1	2	3	4

<u>Overall opinion of the program:</u>

Check the appropriate space.

___ Great program ___ OK

___ Pretty good ___ Not useful

This form is adapted from various sources.

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SOFTWARE SELECTION, EVALUATION AND PURCHASE

A. Develop a needs assessment to determine students' academic needs .

1. Reading levels
2. Math levels
3. Language levels
4. Cognitive levels
5. Thinking skills
6. Writing skills
7. Special students' needs

B. Search for existing software to meet the students' needs .

1. Consult computer magazine software reviews,
    a. Classroom Computer Learning
    b. The Computing Teacher
    c. Electronic Learning
    d. Teaching and Computers
    e. Educational Technology
2. Consult various software vendor catalogs.
3. Preview software at local computer/software dealer stores.
4. Preview software at local offices of education .
5. Consult software directories.
    a. Addison-Wesley Book of Apple Computer Software
    b. Commodore Software Encyclopedia
    c. Swift's Educational Software Directory
6. Consult textbook publishers for available software.

C. Consider hardware requirements for software selection .

1. Compatibility of software with existing hardware
2. Consider the memory required to run the software.
3. Consider the DOS requirement of software (3.2 or 3.3).
4. Consider the existing input/output system
    a. Disk drive
    b. Cassette
5. Consider additional peripherals required to use the software.
    a. Game paddles
    b. Joy sticks

D. Investigate software company's policies for previewing software.

1. Software company grants preview time

   a. Preview period - 30 days

   b. Different procedures for preview

      (1) Company requires a purchase order, but will give full refund if software is returned.

      (2) Company gives no refund on returned software, but will give credit for other orders.

      (3) Order by phone is possible, but some company policies require a purchase order number.

2. Software company will not grant preview time.

3. Research policies for a networking system.

   a. Consider the compatability of software and the system.

   b. Consider the additional costs for networking.

4. Investigate the back-up copy policy.

E. Develop goals and objectives for computer use.

1. Identify long-range goals (3 years)

   a. Consider major needs of students from needs assessment.

   b. Consider minor needs of students from needs assessment.

   c. Consider future needs of students.

2. Identify short-range goals (current year)

3. Considerations for development of long and short-range goals

   a. Profile of students assessed

      (1) Age

      (2) Cognitive abilities

      (3) Number of students using computers

      (4) Needs of special students

      (5) Location of computers

   b. Available hardware

   c. According to the needs assessment determine how the computers will be used.

      (a) Drill and practice

      (b) Tutorial

      (c) Simulations

      (d) Computer games

      (e) Problem solving

(2) Logic/thinking skills

(3) Programming (computer literacy)

(a) LOGO

(b) BASIC/PASCAL

(4) Computer awareness

(5) Computers as tools

(a) Word processor

(b) Calculator

(c) Speech

(d) Art

(e) Music

d. Consider educational benefits of software.

(1) Consider how software relates to curriculum .

(2) Consider how software relates to over-all instructional plan.

(3) Consider how the software relates to the cognitive developmental levels of the students.

(4) Consider reading/math levels of software.

(5) Select software that represents all uses of the computer.

(a) Develop a time frame over a three year period to incorporate computer uses.

(b) Develop staff training sessions to implement all uses of the computer.

F. Select, evaluate and purchase software according to short- and long-range goals.

1. Develop a software evaluation form.
2. Establish a software evaluating committe.
3. Establish a software catalog system.

G. Evaluation of goals and objectives

1. Monitor progress for meeting goals
2. Evaluate future needs and goals for expanding the software program.

CLOSED CAPTIONING AND THE LINE 21 SYSTEM--POSSIBILITIES FOR THE FUTURE

Deborah Popkin
National Captioning Insitute

The Line 21 System was developed in the 1970s as a means of delivering closed captions for the hearing-impaired and was designed to be rugged, compatible with broadcast industry standards and equipment, and inexpensive for the consumer. Over the past four years, the system has delivered more than 7,000 hours of closed captioned programming, demonstrating both its reliability and effectiveness.

The National Captioning Institute is examining the future of captioning technologies and the growth of this important service. NCI is also evaluating improvements in the Line 21 decoder and watching developments in other areas related to delivery of captions for the hearing-impaired.

The Line 21 decoder was developed during a period in which television programming in the United States was largely dominated by the television network services. Thus, the decoder unit was designed primarily as a unit for over-the-air reception. The decoder interfaces with all existing color and black and white television sets at the antenna output of the set, and contains its own UHF and VHF tuner. Channel selection and fine tuning are accomplished on the decoder.

The Line 21 Captioning System offers a multitude of services, including captions on programs and commercials, a program listing service, a daily news summary service, a national news service of events of interest to the hearing-impaired, and a weekend Sports scoreboard service. In addition, Line 21 captioning has more recently proven itself adaptable to other developments in the television industry, namely the rapidly expanding growth of the cable and home video industries. The Line 21 decoder can interface with cable TV converters and home video equipment (VCR's and videodisc players), giving decoder owners access to captioning on cable programming and on captioned cassettes and discs released by home video distributors.

Second-generation Decoders

Despite the successes of the Line 21 decoder, NCI sees room for future improvement in a second-generation decoder. Changes and advances in consumer electronics technology may provide an opportunity to improve the flexibility, size, and possibly the price of the decoder.

With the expanding penetration of cable television, a second-generation decoder could be designed as a cable-ready unit and thus substitute for the cable converter now required to receive cable services. While the current decoder can be connected to a cable converter, availability of a cable-ready decoder would mean that only one unit, instead of two, would need to be hooked up to a television set. The cable-ready decoder would offer access to UHF and VHF channels as well as a myriad of cable channels.

In the area of remote control, a new decoder offers exciting possibilities. The current decoder requires its user to change station channels and Line 21 services (captions and text) at the decoder itself. It cannot be operated by remote control and also renders the remote control pad of existing television sets inoperable when that set is connected to a decoder. Designing a remote control capability into a second-generation decoder would improve this situation. Using this feature, the decoder owner could control the power, volume, station channel and caption channel remotely. In addition, connecting such a second-generation decoder to a television without remote control would automatically provide remote control capability for that set.

A third desirable feature in planning a second-generation decoder is that it would be a smaller unit, thereby making it more easily transportable. Users would be able to carry it more easily to friends' homes, hotels, and anywhere else they might have a need for it. Obviously, the connectors for attaching the decoder to televisions would have to remain uncomplicated so that hook-up is a simple process.

The heart of the Line 21 decoder is the decoder module. Recent technological developments in the design of large scale integrated (LSI) chips offer possibilities for reducing the size and cost of the decoder module. This, in turn, could facilitate not only decreasing the size of the decoder unit itself, but may make it possible to integrate the decoder module into new television sets, cable converters, and even home video devices -- both VCR and disc. In conjunction with the trend towards miniaturization and decreasing costs of tuners and remote control devices, all of these tehnological changes may combine to produce a new decoder unit which offers added features at a reduced price. If the cost of the Line 21 decoder module can be reduced, it may be able to be integrated into television sets, VCR's, videodisc players, and cable converters at a small incremental cost.

The educational uses of the Line 21 decoder continue to be an area of great interest to NCI. One recent and exciting development in this area is the captioning of the Corporation for Public Broadcasting/Annenberg Telecourses which are broadcast over public television stations throughout the country. Over the next two years, 97 hours of these educational telecourses will be closed captioned, thereby offering educators and the general public an opportunity to participate in and learn diverse subjects. NCI will encourage all producers of such telecourses intended for broadcast or videodisc usage to close caption these courses.

Teletext Services

Other emerging technologies, specifically teletext, continue to offer some future promise in the area of captioning. However, the teletext industry as a whole has been subject to many fits and starts. Indeed, the Federal Communications Commission simultaneously refused to mandate a broadcast standard for teletext transmission while reserving Line 21 for closed captioning exclusively for at least the next five years.

The lack of availability of teletext decoders continues to be a major problem in getting teletext services off the ground and into the home. Nonetheless, two types of teletext systems are currently being offered in the United States.

The first system is the North American Broadcast Teletext Specification (NABTS) which was proposed by CBS and is to some extent supported by NBC. Neither ABC nor PBS has expressed any interest in providing teletext services in the foreseeable future. The magazine-type text services supplied by CBS and NBC are for the most part nationally oriented. None of the owned and operated stations of these networks has committed to providing a local teletext service, and only one local CBS affiliate has agreed to provide a local service. On the captioniong side, only CBS has used its teletext service as a means to transmit captions for the hearing-impaired. Until NABTS decoders are available to the general public, however, access to such captions is extremely limited.

Several manufacturers are looking toward providing NABTS teletext decoders as early as 1985; however, these decoders are projected to be in the $900-$1000 price range. It should also be noted that such decoders will work only with top-of-the-line RGB television picture monitors which themselves cost $800-$900. Thus, the great consumer expense involved suggests that mass access to NABTS teletext is still many years away.

The second teletext service available in the U.S. is World System Teletext, which is broadcast by cable superstation WTBS and several independent TV stations. In Cincinnati, WKRC broadcasts a teletext service and, significantly, transcodes all Line 21 captioned programming it carries so that it is available to both Line 21 and WST teletext decoder owners. Zenith manufactures a WST decoder in the range of $300. However, unlike the Line 21 decoder which attaches to any existing television set, the Zenith decoder attaches only to late model Zenith sets (some 1983 and all 1984 models). Lastly, neither of the teletext systems, as they are currently designed, can be interfaced with home video equipment due to their high rate of data transmission. In the area of cable broadcasting, the Federal Communications Commission has not mandated that cablecasters pass teletext signals intact, despite strong lobbying for a "must carry" provision by teletext proponents. This is extremely significant since 32 million of the 83 million U.S. households are now connected to cable television and receive all of their television services through their cable hook-up. Moreover, the number of households receiving television via cable is increasing.

Clearly, the Line 21 captioning system has proven itself a rugged and adaptable means of providing access in all broadcasting areas. It is a technology that has opened new doors for the hearing-impaired over the past four years and thus, has been embraced and supported by the hearing-impaired community. NCI is confident that the Line 21 system, with continued support by all sectors of society and the industry, will continue to offer the greatest certainty of expanded access in the years to come.

USES OF AUTOMATIC SPEECH RECOGNITION TO FACILITATE SPEECH COMMUNICATION FOR DEAF AND HEARING IMPAIRED PERSONS

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"Automatic speech recognition" (ASR) is a term often used to refer to a burgeoning technology that has as its goal machine recognition of speech. The machine, a computer, would quickly transcribe conversational speech into print or perhaps into some enhanced acoustical form. If is easy to imagine how useful this technology might be to facilitate speech communiation for deaf or hearing-impaired persons. For those with profound deafness, communication with the hearing world would be possible via near-instantaneous automatic captioning. For hearing-impaired persons, the speech-recognition system could be coupled to a device that would enhance speech acoustically--a kind of sophisticated speech-processing hearing aid. Such a hearing aid could be customized for individual hearing-impaired persons to enhance the speech characteristics that are least audible, thus facilitating speech perception for these persons.

This paper describes several future applications of automatic speech recognition for deafness: specifically, ASR for telephone use between a hearing person and a deaf person; a speech-processing hearing aid that would require ASR; and the use of ASR for speech-training with deaf and hearing-impaired persons. In addition to applications for deafness, some educational uses of automatic speech recognition for hearing persons are discussed. Educational applications of ASR might be useful for hearing-impaired children.

Current Technology In Speech Recognition

Various systems that will recognize speech are commercially available today. However, these systems have limitations as to the quantity and quality of speech that can be recognized. For example, most systems will recognize the speech of only one talker. The system is "trained" for this talker, i.e., samples of the talker's speech are stored in the system for subsequent comparisons with words undergoing recognition.

A further limitation of today's ASR systems is that they permit the use only of relatively small vocabularies. The vocabulary that a talker can use with a system may be restricted to 150 words or fewer.

An additional limitation is that inaccuracies in recognition sometimes occur. These recognition errors are often caused by acoustic variations between tne word to be recognized and the samples of that word stored in the system. The acoustic variations may be substantial if the talker uses a different rate and/or style of speaking for the word to be recognized, in relation to the speaking rate and style used for the stored word.

"Word recognition" may best describe what many commercial systems do, since they can "recognize" only isolated or discrete single words spoken with pauses (less than one second of silence) occurring prior to and following each word. A few systems that are more sophisticated can recognize a small series of connected words, such as the numbers in zip codes. However, no machines are available that can provide word-by-word recognition of continous conversational speech.

Most of the current applications for word recognition systems are found in industry. ASR systems are particularly useful for jobs in which a worker's eyes and hands are simultaneously occupied by some task. With these so-called "eyes busy/hands busy" tasks, the use of automatic speech recognition enables the worker to accomplish some additional activity, such as operating a machine by speaking instructions into an ASR system coupled to the machine.

The Word-Recognition Process--Simplified.

Commercial ASR systems typically accomplish "recognition" by finding the best acoustical match between the spoken word to be recognized versus the vocabulary of words stored in the system. The acoustic characteristics are compared between the spoken word and the stored words. The comparisons are made of the characteristics as they occur temporally throughout the words.

Some of the major stages of the recognition are:

1. The spoken word received at the microphone must first be transformed from an acoustical to electrical signal. The electrical signal is then converted to a digital form to enable processing by the system's computer.

2. A further step is determining the beginning and end of the word. The start and stop boundaries of the word are found by locating the areas where acoustical energy is absent in a temporal section that includes the word and the pauses on either side.

3. Acoustic characteristics are measured throughout the word. From the beginning to the end of the word, analyses are conducted of adjacent temporal sections, or time slices, that may be as brief as 1/100 of a second in duration. Each slice is analyzed for its energy content among different bands of frequencies.

(Other types of acoustical analyses are used in some systems. For example, measurements may be made on the basis of acoustic characeristics that are important for hearing (perceiving) the differences among words. Time-domain measurements provide the best temporal resolution of speech.)

4. In a later step, the acoustic characteristics of the word's time slices are compared with the series of time slices for each of the words stored in the system. (Some systems make comparisons between words, of only selected acoustic characteristics, rather than comparing all time slices across the words. Segmentation permits the systems to match selected parts of words. These types of processing generally require less time in computation.)

5. The spoken word has been "recognized" when the system selects one of the stored words that represents the best acoustical match for the spoken word. The time required for this type of recognition process averages about one second. The accuracy of recognition ranges from 60-80 percent for the limited vocabularies permitted by the system.

Applications of ASR for Deafness and Education

Research is going on for some experimental ASR systems that would be used for telephone communication between deaf persons and the hearing world. Other studies are underway to examine improved speech comprehension via signal processing, which could be used in future speech-processing hearing aids that would require the use of automatic speech recognition. However, these efforts are still in experimental phases. For nonexperimental, i.e., commercially available ASR systems, there seem to be no existing applications for deaf or hearing-impaired persons. For hearing persons, some educational applications using available ASR systems are ongoing or planned.

For telephone use between deaf and hearing persons, an application of ASR is under study and development at the Speech Research Program of SRI International. In this application, ASR would be used to transform the speech of the hearing person into printed text for viewing by the deaf person. To respond, the deaf person would use a TTY, with the output of the TTY converted to synthetic (artificial) speech for reception by the hearing person.

The deaf person will use a video display to see the message spoken by the hearing person. This display would show the words recognized by the ASR system. The TTY used by the deaf person would have a special keyboard that would eliminate the need for letter-by-letter spelling of text. The keyboard would be comprised of symbols that each represent several different letters. This low-redundancy keyboard should facilitate text generation, and thus speed communication. Some of the keyboards under study are an anticipator, a stenotype, and a conventional QWERTY.

In the computer's recognition of the speech, some percentage of error is likely. Thus, a precise and specific transcription of the spoken message will not be presented regularly on the video display seen by the deaf person. That is, the system may choose or "recognize" several words that represent approximate acoustical matches to the spoken word. For each word spoken, the words selected as approximate matches by the system will be displayed simultaneously on the video. Thus, for a spoken sentence, the video would show a "sentence-lattice," which is a kind of word matrix presenting a sequence of sets of words. The sets contain words acoustically similar to the words spoken. The deaf person would then select the most meaningful and probable message from the sentence lattice.

At the current stage of development, some devices of the system are being examined experimentally for communication efficiency and accuracy. Laboratory versions of the devices that will handle the text typing and video display are being tested with hearing and deaf persons.

For some reading tests of sentence lattices, reading speeds of 20 to 40 words per minute have been obtained for hearing persons. This is slower than the reading rate for ordinary text, which is about 250 words per minute. (Current research in reading de-emphasizes words per minute as a measure of reading rate, in favor of other indices, such as reading comprehension.)

Text generation by deaf persons using the different keyboards under study showed no significant improvement in speed with the low-redundancy keyboards over that with the ordinary keyboard, which averaged 20-55 words per minute.

Further study is planned for a laboratory version of the complete system, which will include both input and output devices. Communication efficiency will be examined for deaf and hearing persons simulating real-life use of the laboratory system.

Phone Use Via Available Technology

The system just described may be used in the future for telephone communication between hearing versus deaf persons. In the near term, existing technology may be adequate to enable phone use for limited messages between a deaf person and a hearing person who communicate frequently, for example a married couple. A commercially available word-recognition system combined with a word synthesis system could be used to store spoken samples of a restricted number of prearranged topics of limited vocabularies, such as grocery items or commuting times. A phone and TTY could be coupled to these systems to convey messages via a series of discretely spoken words.

At the beginning of each use, the system would be alerted to the communication topic by a touch-tone code. The systems would then convey messages utilizing only the vocabulary words stored for that topic. The ASR system would recognize the speaker's message, which would be printed on a TTY for the deaf user. The typed reply of the deaf user would be converted into artificial speech for presentation to the hearing user.

Future Speech-Processing Hearing Aids.

Experimental ASR systems have been developed that recognized speech in part, by identifying acoustic features or cues in speech. (Speech acoustic cues are the acoustic segments by which consonants or vowels are differentiated for speech comprehension by hearing persons.) Such ASR systems could operate as the front-end of a speech-processing hearing aid that would enhance or exaggerate acoustic cues that are difficult for deaf and hearing-impaired persons to hear.

First the hearing aid would recognize a talker's speech. As part of the recognition process, the system would be programmed to spot particular acoustic segments that are inaudible or imperceptible for the hearing-aid user. Next, these segments would be specially processed by the hearing aid to optimize their audibility and thus facilitate speech comprehension for the user.

At Gallaudet, studies are underway of the types of enhancements of acoustic cues that will improve speech perception for hearing-impaired and some deaf persons. Thus far, we have examined enhancements for certain consonants in the final positions in words. For these consonants with enhanced acoustic cues, most of the hearing-impaired persons we have studied have shown rather large improvements in consonant perception.

ASR in Education.

To date, the proposed uses of ASR for deaf persons have been for communication situations in which an ASR system recognizes the speech of the hearing person. Other uses of ASR for deafness that we might envision could require recognition of the speech of the deaf person. For example, in education, ASR could be used for machine teaching where the deaf person speaks, in order to communicate with the machine. This approach is under study in one experiment on speech training for deaf children, which is being carried out at Boys Town Institute in Omaha.

For this project a special speech training aid has been developed that uses automatic speech recognition to assess children's speech in training. In the recognition state of the training aid, a sample is stored of a word being trained for the deaf child. This stored word sample represents the child's most intelligible or best production of that word. During training, the stored word is compared to additional utterances of that word spoken by the child. If the acoustic characteristics are similar between the stored word and newly spoken utterance of the word, the training aid presents positive feedback to the child.

Data are being collected to evaluate the effectiveness of the experimental aid. One advantage noted thus far is that the children seem more highly motivated in training with the experimental aid than with procedures using traditional training approaches.

Automatic speech recognition systems are being adapted for use in education with hearing persons. An ASR system is commercially available for applications in compute -assisted instruction. The system uses a question and answer format for the instruction process. The student's answers are spoken for recognition by the system. The video presents the questions to the student and also provides feedback following an answer. The time required for the system to "recognize" the student's spoken answer is less than one-fifth of a second.

Other projects are underway to use an available ASR system for teaching children to read. In one program, visual tests will be used to present a story to the student. The story sequence will proceed only as the student reads aloud certain key words of the story. The words must be read and spoken correctly to continue the presentation of the story text.

For deaf persons who speak, future educational applications of ASR may be possible besides those described for speech training. Such applications may be most successful for hearing-impaired persons who can maintain fairly regular acoustical patterns in their speech. Consistency in speech acoustical patterns will be important in order to reduce errors in word recognition by the ASR system. A frequent cause of word-recognition errors in existing ASR systems is irregularities in the acoustical pattern of the word to be recognized. That is, for a given word, the acoustical patterns must be fairly similar between the spoken word and samples of that word stored in the system.

In summary, commercially available ASR systems recognize only single words spoken in isolation by one talker. Using today's technology, recognition of continuous conversational speech spoken by different talkers is not yet possible. The application of automatic speech recognition for deafness and education that seems most feasible in the near future is that of telephone use between a deaf person and a hearing person. At Gallaudet, studies are planned of phone use for communication of limited messages between hearing and deaf persons.

ELECTRONIC MAIL FOR THE DEAF--WILL IT WORK?

Earl Craighill
SRI International

This paper discusses some investigations we have been conducting into an efficient, low-cost telephone replacement for the deaf. A long-term goal of this work, funded by the Department of Education and the Department of Commerce, is to investigate a wide range of telecommunication services for the deaf that might be provided through a nationwide access network.

Background

The key objectives of our studies are to define an affordable, useful, new communication service for the deaf, and to assess the viability of developing commercial computer-communication networks to provide these communication services to the deaf community on a nationwide basis. The motivation is to help the deaf overcome the difficulties they experience in using the telephone system, radio, and, to a certain extent, TV in this modern communication-intensive world. In the process of achieving this goal, the deaf and other handicapped individuals could become the vanguard of the computer-based communication movement rather than continuing to lag years behind the technology. The combined service that we describe (denoted DNAS--Deaf Network and Associated Services) would allow access by existing Baudot/Weitbrech Telecommunicaitons Devices for the Deaf (TDDs) as well as by ASCII terminals with Bell modems and would provide limited intercommunication between deaf and hearing.

The more than 40,000 Baudot TDD's used by the deaf today are primitive devices when compared to the half million ASCII computer terminals now in general use. Faster and more reliable, the ASCII terminals offer more features for the money. More important, the ASCII standard is used almost exclusively in the ever-growing number of computer-communication systems and personal computers.

Is It the Right Time for Computer-Communication Services?

The Deafnet demonstrations have offered the deaf valuable exposure to new technologies, while giving researchers fresh understanding of the deaf user's needs. The research has shown, for instance, that computer based mail systems (CBMS) for the deaf should have features which are also suitable for the broader market of home consumers. In particular, the system should be easy to operate and affordable, with charges based more on the services used rather than time spent on the system.

But the full potential of electronic text services for the deaf community will not be realized until several transitions are completed. First, the telecommunications industry itself is not only growing rapidly but is in the midst of a massive restructuring due to the Federal Communications Commission's (FCC) deregulation decision in its industry competition and superior products at lower prices. Computer

Inquiry II probably will bring with it a shift to cost-based pricing of telephone services. Second, as the telecommunications industry grapples with internal restructuring, it will, at the same time, be struggling to penetrate a marketplace that may resist some of its newest products and services. Finally, as part of this general process of innovation diffusion, the deaf will be facing still another change that is even more directly relevant to their immediate concerns: the technological transition from outmoded Baudot teletypewriters used exclusively by the hearing impaired to ASCII-standard terminals used in computer-communications. This transition will not only minimize the cost of serving the deaf, but will also lead to the fullest market penetration and the largest overall net social benefit.

The Deafnet experiment, while it has demonstrated technical feasibility, falls far short of demonstrating ultimate commercial viability on a nationwide basis. To be profitable, a product or service must be low enough in cost to attract customers willing to pay for it. Although the cost of computer hardware has dropped dramatically in recent years, telecommunications costs (as seen by both supplier and user) have stayed relatively constant. For DNAS, we expect some economies, but not substantial ones. Whereas communication costs are estimated to be about 33 percent of total costs for serving the urban population, they might constitute as much as 51 percent of total costs for the rural population, resulting in an overall figure of 42 percent for a system reaching all users.

The communication systems the deaf use must be convenient, affordable, and reliable, with adequate privacy protections. As the present incompatibility between Baudot and ASCII standards demonstrates, the communication system must be flexible enough to accept or adapt to technical improvements as engineers and vendors make them available.

A communication system for the deaf must be responsive to its users' multiple limitations. Specifically, the system must be easy to use with a minimum amount of training. Because a written "conversation" between two deaf individuals will take significantly longer than its spoken counterpart, user costs should not be determined solely by time spent on the system.

In short, the public at large must become more aware of, and confident in, the ability of electronic text systems to function as partial replacements for traditional telephone service, mail delivery, and publishing. To put it differently, the proponents of computer-communication services must acknowledge and solve the problem of innovation diffusion, the means by which society learns of, and begins to use, a new product or service.

What Should "Deafnet" Provide?

In general, most Deafnet users interviewed were very enthusiastic about the system and hoped that it could continue. As the reported usage data suggests, by far their favorite feature is the electronic message service. The popularity of this service explains many respondents' desire that their friends be on Deafnet and that Deafnet be expanded to more areas of the nation.

A number of users suggested that newsletters and workshops explaining how to use Deafnet would be helpful. These suggestions reflected the feeling of many respondents that they did not understand how to use Deafnet as well as they would have liked, often because they felt the manual was confusing or because they were unaware of, or felt uncomfortable with, the on-line instructions. These comments point up the importance, whatever the service, of simple instructions and ease of operation.

When asked about features that should be added to the system, the most enthusiasm was expressed for a communication or answering service of either a voice-text conversion type or a standard message service.

How Much Should Deafnet Cost?

A majority of the respondents said they would be willing to pay the somewhat higher bills (almost always under $20) that we expect for similar usage patterns on a commercial nationwide system. It seems likely that, if the system actually were nationwide and had a large number of users, its value would be increased considerably beyond what is perceived at this point, since its practical value as a communication device would be so much greater.

The recent California legislation and the CPUC implementation program to have the telephone companies distribute dual-mode TDDs to certified deaf individuals at no additional cost above the standard monthly phone charge will generate a large population of ASCII-compatipatible terminals for use by the deaf. As this type of legislation spreads to other states, even more users will become aware of, and skilled in, new communication capabilities. They will also begin realizing the (proportionally higher) cost of using direct distance dialing over the telephone network for terminal communications. This will spawn a group of users familiar with terminal equipment who demand lower-cost communication systems. The terminals will be (nearly) compatible with digital networks and thus can take advantage of them as well as force the development of better communication services.

Cost is an especially critical factor for the deaf, who often have low incomes due to their comparatively limited employment opportunities. Whether one is considering conventional telephone service or the most sophisticated computer-communication system, cost can be divided into two elements: (1) the cost of terminal equipment and maintenance and (2) the cost of transmission services.

Prices for conventional TDDs range from $450 to $750. TDDs can be leased from the telephone companies at per-monthly rates from $6.68 (Michigan) to $15.30 (Kentucky). Of course, the convenience of leasing may surrender the choice of TDDs to the telephone company, which may, unwittingly, frustrate the distribution of new equipment using the ASCII standard.

Improved software and processing ability could represent an important breakthrough for many deaf users who are intimidated by the new technology or frustrated in its use, given their sometimes poor language skills. Personal computers are not inexpensive, although a few already are competitive with conventional TDDs with prices ranging from $399 to $2,500. The sheer number of models, brands, and prices may intimidate some potential users. This characteristic, combined with the fact that retailers will often offer discounts of up to 30 percent for bulk orders, suggests an important role for leaders in the deaf community: a computer-communication system may be more successful and economical if it is introduced simultaneously to a group of deaf users. A group introduction, however, requires persuasive and organizational skills--which are less likely to be found at a Radio Shack outlet than at a church, school or community center with an active program for the hearing impaired.

In August, 1981, AT&T filed a revised tariff at the FCC seeking to reduce interstate rates for speech and hearing-impaired customers. The normal (maximum) long distance rates of $25-day, $16-evening and $10-night were reduced to $16-day and $10-evening and night.

Thirty-six states now offer reduced intrastate rates to the certified deaf, with similar tariffs pending in two more states and another on file in Texas. Of these, 18 states have plans which are similar to the reduced AT&T interstate tariff. In the other states, the deaf receive a 60 percent discount off the basic day rate at all times.

Less expensive alternatives are available, however. Deaf customers who place a substantial number of long-distance calls, for example, can subscribe to one of several low-cost, long-distance services now offered by MCI, Southern Pacific Communications and other companies. Time-sharing systems may also be cost effective, especially for computer-communication systems. For instance, Telemail's night time rate of $4 per hour is significantly lower than AT&T's. Telemail's customers can further minimize transmission costs by using a personal computer to compose and store messages before they are sent. A printer combined with a personal computer would achieve similar economies for receiving messages. GTE requires that customers spend a minimum of $500 per month for Telemail service; in addition, the company imposes a $140 monthly subscriber charge. Although $640 may not be feasible for an individual subscriber, it is economical for groups of 120 or more.

Who Should Promote Deafnet?

Leaders of the deaf community have an opportunity to play a pivotal role. They could, for instance, fight fiercely to preserve the status quo, i.e., mandatory leasing of TDDs and rate discounts. However, they do so at a risk. Computer Inquiry II did not spawn the changes now taking place in the telecommunications industry; rather, the FCC's recent decision has only accelerated an already well-established trend toward competition and cost-based pricing--a trend which is driven by technological progress.

Should the deaf community devote its efforts to preserving the status quo, it may miss important opportunities to influence the business and policy decisions which will shape an ever-changing technology. New computer communications hold far more promise for the deaf than today's telephones and TDDs. However, without participation from the deaf community, these new technologies may develop in ways that are not as beneficial to deaf users as they might be. In short, the deaf community may discover that while it was fighing one battle, it lost others which were ultimately far more important.

Leaders of the deaf must be educated--and quickly. They, in turn, must reach out in three directions: to deaf telecommunications users; to the computer-communication industry; and to state and federal policymakers. Whether one labels this process "innovation diffusion," "education," or simple "marketing," its purpose is the same: to ensure that members of the deaf community have access to a new technology that is convenient, affordable and responsive to their communication needs.

The major conclusion we draw is that a service for the deaf must provide basic communication services akin to the telephone system--a service that is economical, convenient, and fully integrated. A $5-$10 per month charge for the additional convenience of a computer-based system is not unreasonable and would likely be paid willingly by deaf users. If, further, less-expensive long-distance communication could be provided by such a system, then a per-user average charge could be on the order of $15-20 per month. We estimate that a person typing on a TTY would take 5-9 times as long as a talking person to convey an equivalent number of words. At long-distance phone rates, this can give a deaf user a considerable phone bill each month.

What is an Acceptable Pricing Policy?

From the supplier point of view, startup and provision of the basic communication service represent the largest portion of the cost. Thus, we need to consider carefully whether the consumer can afford this service. From a (deaf) user point of view, we need to make a distinction between 1) economically usable services, 2) urgent services that are not available now but would be used if available, and 3) enhanced services. The enhanced class of service can be provided without much additional cost and so has the potential of contributing primarily to profit. The key, is to define enhanced services that will be attractive to the deaf community. Representative basic services are computer-based mail, terminal-linking, and online news reports. Examples of enhanced services are games, entertainment guides, home delivery of educational courses, and recipe libraries.

Finally, a good evolutionary strategy would be to start by offering services that the deaf can afford, where the payment is just a substitution within the family budget. Once subscribers begin using such services and become familiar with the new skills and concepts, there is an easy and likely transition to begin using the service for entertainment, business, and other activities. This evolution easily leads to a built-in market for the enhanced services.

The architecture or structure that we recommend is based on "tiered charges" or cost-based pricing. That is, the user should be able to select the services he wishes to use and pay only for those services. This tiered-charge model is distributed and uses regional community centers. The regional centers are connected by a Value Added Network. Each of the regional centers can be tailored to match the communication requirements and available capital (investment potential, income) of the local community and to provide specific services.

This model makes no restrictions on the type of hardware or software used to implement the regional centers, but rather requires only standardized communication procedures. They are of three types: terminal mode, block mode, and message mode. With this structure, a wide variety of services and methods of access can be provided.

Conclusions

We have discussed the commercial feasibility of DNAS in terms of specific costs and revenues for a target population of users. However, it should be stressed that these costs and revenues, though they appear to be appropriate and reasonable, are based on models and assumptions that bear further investigation before proceeding to build the network.

The goals of the DNAS design are to develop and integrate communication services that can be used by the deaf on a nationwide basis, meet the special needs of the deaf, offer services comparable to those received by the hearing, and become self-sustaining. The plan is based on an evolutionary architecture, since there are already some pieces of the system in use now.

The participants in the evaluation are:

USERS--The subscribers who use DNAS for communication. They consist of the hearing-impaired population, plus families and acquaintances, churches and schools, and others who can benefit by using the system.

PROVIDERS--The entities that provide services to the DNAS and to subscribers individually, both directly and through the system. Included are equipment manufacturers, maintenance contractors, common carriers, information utilities and distributors, etc.

POLICYMAKERS--The governmental entities whose intervention may be required to help the deaf community to obtain leverage and make its special needs visible.

CATALYSTS--Those who expedite the development of DNAS. Included are government agencies, various sponsors, research and development organizations, and volunteers.

The technological alternatives for various elements of DNAS can be stated, with standards shown as the key. A broad range of innovative services is promised in the marketplace, and it should be stressed that unified, simple access to them is an important aspect of DNAS. The potential of personal computers as home terminals and as the medium for implementing services is a key ingredient, and their strengths and deficiencies need to be considered.

In summary, many factors are involved in determining how viable a commercial Deafnet would be. Costs, revenues, prices, and the way in which the network expands are primarily economic determinants. But the success of DNAS will depend ultimately on the users themselves and on their own leadership in fostering its growth.

PERSPECTIVES ON TECHNOLOGY APPLICATIONS FOR THE DEAF:

I ADMINISTRATION

II TEACHERS

III EMPLOYMENT

IV REHABILITATION

I

PERSPECTIVES OF AN ADMINISTRATOR ON TECHNOLOGY APPLICATIONS FOR THE DEAF

Dennis Gjerdingen, Administrator
Clarke School for the Deaf

As administrators it is our job to go back to our schools and do something about optimizing computer use.

Currently, I am President of the Clarke School for the Deaf, so I have to carry the burden of bringing technology into our schools. I was formerly the Headmaster of Central Institute for the Deaf in St. Louis, where I was also an Assistant Professor of Education and taught education of the deaf. In addition, I have done a good deal of research and clinical work, and I am a parent of a deaf child. So I think I have a number of aspects of working in the field of deafness to discuss.

There are two things we are focusing on here. One is technology in education; the second is technology in communication. We must recognize that computers offer us the greatest tool we have ever had to add to our profession. But they are only tools and must be used in a professional way. As our futurist warned us, "If we are to deal with children, we must understand child's play." We must not forget those children and the directions in which we have to lead them.

Yet, computers are often used in schools as electronic seatwork. They are doing nothing more than what has been done 100 ways before through workbooks or dittos or any number of other clever teacher-devised means. Here we have the greatest tool that has ever been available to us, and we have not taken advantage of it.

Computer incentive has to come from the classroom teacher, not from the administrator. Our job as administrators has to be to facilitate and make development happen; direct it, not impose it. We have to bring that to fruition from our staff.

The computer represents the most powerful tool in our trade. But it is only a tool, and it is useless unless utilized properly. The computer, more than any other single innovation, is going to force teachers and administrators to start looking much more at learning outcomes, rather than at teacher production; looking at what the student is doing, rather than what the teacher is doing. And once we really understand those learning outcomes, once we know what we want to accomplish with those children, this great tool is there to help us do it over and over again.

Let me give you an analogy. When I first came to Clarke School, our media director was talking about spending all this money on this kind of equipment and that kind of equipment; and I said, "Show me a good teacher, and give her a piece of stone, and let her write on a piece of stone, and you will see a great lesson going on." A media technician who had been sitting there listening looked up at me and said, "Yes, and give me a video camera and I'll record it for posterity." And therein lies one of the greatest uses of the computer. We can take those masterful lessons, preserve them for posterity, build in the needed learning outcomes, measure them, and use them over and over again.

The computer is a powerful tool. We must give deaf children the capability of using the language they need to use this tool. There is nothing more important than understanding the language system. The critical challange to our field is to find ways to communicate the English language to our deaf students and make certain that they can gain command of it.

We cannot merely talk "at" our staff. We have to involve, we have to entice, we have to motivate. It is <u>from</u> administrators that this great new tool is going to be implemented, but not <u>by</u> administrators. It has to be done by the classroom teachers.

The second focus of this conference is the implication of computer use for communication. If we achieve the first focus--the proper education so that deaf people have the capability of using this wonderful tool with the language competence that they need with which to use it--then the computer suddenly has become the great equalizer. It does not matter whether or not you can hear when the computer is used as a communication device. The things that we have seen here over the last few days bode very well for the future of deaf children.

This is a tremendously exciting era. There are more opportunities for deaf people than there have ever been, and it is incumbent upon us as administrators to make them available. Ten years from now, let us not look back at the opportunities we had and bemoan the fact that progress in deaf education has not moved forward. Let us take this tool, accept the challenge, and make progress happen.

II.

PERSPECTIVES OF A TEACHER

Gerilee Gustason, Teacher
Gallaudet College

What we see, what we hear, and what we know about what is happening in computers and technology is fascinating, scary, and frustrating for me as a teacher. At the same time, it fills me with anticipation. The reason for the facination is obvious. What is scary is do you expect us to understand it all and teach it to children who already know more than we do about computers? At the same time there is frustration, not just because we know we have to keep up with information, but also because we all experience some negative results with computers. How many times do we hear, "the computer is down"? Perhaps in relation to administrators, what happens is that the records we need on the students are not there or are not up to date.

My background relates to secondary level teaching in both residential schools for the deaf and day public school programs. My focus is on the teaching of English. I am now at Gallaudet College with the teacher preparation program with both deaf and hearing students. At the college level, it is very hard to appreciate how wonderful computers are when it takes the registrar over six weeks to get a class list to me. One of the things I hear from teachers many times is the problem of student recordkeeping. So far, computers have not been a lot of help in this area for the classroom teacher. The help may be there, but we don't know enough about it to use it well.

Another problem area is the attitude of some teachers: "What new thing will the administrators propose this year?" Every year it's something different. Every year they have a workshop, its for one or two days, and learn what they are supposed to do that year. Sometimes it is behavioral objectives or Bloom's taxonomy. This year it's computers. One more workshop to sit through or maybe doze through. Nothing really changes in the classroom, so I believe if you really want changes there, you need more than workshops.

At the same time, we have enough contact with this technology to know our students have to learn it, they will have to live with technology even more than we do. I can see some of the possible applications, in the classroom and out of it, and they are very exciting. How can this technology help me as a teacher to do a better job teaching? You remember the song from My Fair Lady, "Don't talk of love, show me." Don't talk about technology, show me. How can it help me do my job better?

The first question is what to teach? In curriculum and lesson planning, will technology help me? The sad part is that I keep hearing: not yet, not much. The software for our hearing-impaired students is very limited, especially in the biggest problem area, teaching English. On the one hand, we know how important language skills are going to be in the future, but at the same time there is no software for this. You can put the curriculum and the lessons that you are teaching now in there, but if we had the perfect curriculum our kids would have perfect English already. They don't. It sounds as though we will take what we're doing and put it on the computer. We won't be doing much better than we were. However, you are asking us to put in more time on the job to put that stuff in the computer.

Nonetheless, there are possibilities in other areas, not just in deaf education. What about ESL, English as a second language? Is there any software? What about driver education? Materials for the teaching of ethics, morals, health and nutrition? What about new jobs opening up? What about career education information for the students? Vocational education? We really want to know what is out there. The kind of program KDES reported on that might share information about software sounds great, but it is depressing to see how little they found that was usable with hearing-impaired students. The potential is fantastic, but it is not here yet.

After the question of what we teach, there is the question of how we teach it. Again, the potential is great. Even if we use only what we have now, it could save the teacher a lot of work just to use the word processor and keep material on the computer, modify it a little for different students and different classes. That is what will help me.

Secondly, even if we don't have the software for lessons, why can't we use the word processor with the students? We want them to work on language. Why not work on it on the computer with the word processor? They can then go back and change errors. It doesn't mean they would be rewriting the whole paper, so you have a double bonus: experience with the machine plus work on English. Also, we have the potential of individual drill work on the computer.

The third area after what to teach and how to teach it is keeping track of how the students are doing through the year and relating this to IEP's. This is not always accessible to the classroom teacher if there is only one computer in the building. Give the teacher a small, inexpensive computer in the classroom and there's a big difference. That wouldn't scare me as much. I would use it, and I would learn what it can do.

One of the most exciting possibilities is information sharing, especially because the majority of our students are not in big programs now but are mainstreamed in small classes. The teacher and the children are becoming isolated. They need information, they need contact. For example, in teacher training, we have a difficult time trying to keep on top of teacher certification requirements in different states. What are they? Can I move? Am I stuck? What about all of the different curricula that schools have already developed? If we get that type of information in a computer base somewhere, with some way of calling it up, it would be fantastic.

What about information on meetings and conventions? Teacher-to-teacher communication over the phone is fine, but getting together sometimes and showing what we are doing with the children helps a lot.

What about parent information? In a lot of places, you can't work with children below the age of three. Their parents often have no way of getting information especially if they live out in the country in an isolated area. How do you communicate with them? What about parent education, correspondence courses through telecommunications? What about information sharing in special areas? We get more and more questions about gifted deaf students. Who is doing what with a program for gifted deaf students? Who is doing what with the gifted hearing, for that matter? That kind of information tracking would be a great help.

Also, we must think about what will happen to our children after they leave school, not just in the work sense, but personally; what about telecommunications for them? I have found that with high school students, captions on television and the TTY are excellent motivation both for reading and for English. The more effect they have, the better off we are. What about the children who are isolated in small programs? How do you establish contact with other deaf children? The telecommunications concept could work wonders in that.

One of the things that I keep waiting for is voice-to-print capability, not just for education, but for the telephone. With the phone, for example, what do you do with a mainstreamed hearing-impaired high school boy who wants to call his hearing girlfriend and has to go through his mother as the interpreter? He won't do that for very long. That kind of voice print capacity would really help young people socially as well as educationally. We keep waiting. Again, the potential is fantastic.

What the individual classroom teacher may know is often just enough to be scared, especially when we hear that states are going to start requiring computer literacy for certification. You mean, I have to know what a byte is? What Fortran is and how to use it? I have to program a computer myself? How do you really convice the classroom teacher? Again--show me.

The best thing that happened to me personally was the Apple. Two summers ago I was writing a book of 450 pages on my electric typewriter. I did it the hard way. I went back and rewrote it again, I corrected it and after it was finished, then learned word processing. That kind of experience with word processing has turned me on but good.

So first, give me that kind of experience with what can happen in the classroom, with recordkeeping, with lessons or whatever, and show me how to do it myself. Secondly, don't tell me how wonderful it is from up above. Let another classroom teacher who is interested and already doing something good get me hooked because I want to do that kind of thing, too. Third, give me the information about what is possible now, not tomorrow. Don't scare me with stories of what my students have to learn until I know it first. What do we have now that I can use now to make life better for me and the students? What's coming that is exciting, such as (I hope) automatic captioning. Then I'll be receptive to computers.

III

PERSPECTIVES OF AN EMPLOYER

Steven L. Jamison, Employer
IBM

This conference has focused on the impact of technology on the education and communication of deaf persons. We have been reminded here that, after thousands of years as an agrarian society, technology changed us rather rapidly into an industrial society. And now that society is giving way to an information society. Technology is the bleach that is turning blue collars to white.

The Impact of Technology of the Educational Process

Most of the workshops I have attended have dealt with the ways that technology is influencing instruction. Particular emphasis has been given to the role of the microcomputer in the classroom or the instructional laboratory. We have heard about and seen demonstrations of a bewildering array of personal-sized computers running a wide variety of software and courseware offerings. Computer-aided instruction has expanded beyond the simple drill and practice to simulation courseware that promotes the development of problem-solving skills. Local area networks tying multiple computers together and to a common database are beginning to show real promise in instructional environments. We have heard about the power of videodiscs, especially in a random access mode, to provide new dimensions to CAI systems. Light pens, graphic tables, touch screens, and even speech recognition provide students with alternate ways of communicating with their teaching computer. And it seems that no subject area is immune: English, math, science, social studies, business and driver's education.

One workshop discussed administrative applications of microcomputers. It seems quite clear that properly designed systems can assist greatly in many important areas here, particularly in maintaining student records. But schools are also increasing their efficiency and effectiveness in such applications as planning, budgeting, projecting, accounting, scheduling, monitoring, reporting. Complete packages exist for specialized applications such as IEP development and reporting.

Although there were some references to research studies, this area did not seem to be getting the attention it should have. Computerized instructional aids are clearly having an impact, but what instructional strategies are most beneficial? The ability to capture data on student performance and to use the microprocessor to do statistical evaluations is undoubtedly being utilized at various schools, but was not covered in the sessions that I attended. As Harold Pluimer said, "We need to be more concerned about where we are going than how fast we are moving."

The Impact of Technology on Educational Content

The world of work that students are inheriting is becoming increasingly sophisticated and complex. Not too long ago, nearly everyone was a farmer, relying on one's strength, and success depended on what one could grow. Then technology made possible farming equipment that multiplied the productive capability of the farmer, freeing up more people for the expanding industrial economy. Now only about 3 percent of the work force is directly concerned with growing food. The industrial revolution substituted the factory for the farm as the principal work place. Equipment took over the heavy work and made manual dexterity more important than muscle power. But technology is changing all that again. The introduction of various forms of automation, most recently robotics, has reduced the number of people employed to make things to about 13 percent of the work force, and that percentage will continue to decline.

People left the farm for the factory; now they are leaving the factory for the office. John Naisbitt, in his book, Megatrends, states: "Now more than 60 percent of us work with information as programmers, teachers, clerks, secretaries, accountants, stock brokers, managers, insurance people, bureaucrats, lawyers, bankers, and technicians. Most Americans spend their time creating, processing, or distributing information."

Truly, we are an information society. And just as truly, the educational preparation of our young people must reflect that society. More clerks and fewer welders tells only part of the story; the work of the clerk is becoming more sophisticated, requiring a real understanding of the principles involved, not just the mastery of techniques or procedures.

And in most fields, the professional sector is growing the fastest: accountants rather than clerks, programmers and analysts rather than operators, engineers rather than technicians, etc. Most professional positions require bachelor degrees, but not enough deaf students with the potential for doing professional work are getting to college. Many who do have college training have entered careers where they serve other deaf people. Clearly, we will continue to have need for teachers, administrators, counselors, and mental health professionals, but a greater percentage must find employment in the mainstream of our economy. In either case, the demand for better educational preparation is clear.

But probably the greatest impact of technology on employment is in semi-skilled job classifications. Robots and other automated procedures are eliminating vast numbers of jobs as assemblers, welders, etc. Even testing and inspecting jobs can frequently be done more efficiently by machine. Competition with foreign companies as well as with other American firms is forcing this trend on the manufacturing of automobiles and furniture and clothing and telephones and computers. IBM typewriters are manufactured in Lexington, Kentucky, in a plant that utilizes a very high degree of automation. And Mr. Pluimer told us of a Japanese firm that has completely robotized the plant where it makes robots.

The new jobs that are created by the new techologies tend to require new skills that depend on increased technical competence. Even manufacturing is becoming more "knowledge intensive" than "labor intensive," putting a premium on people who can plan, design, set up, and check out, rather than perform repetitive tasks. Those who cannot be retrained will be blocked in their upward mobility and may even slide into lower levels of employment. Some of the educational technology that has been discussed here is being used in business and industry to help retrain people whose skills are becoming obsolete.

Manufacturing is not the only area to feel the impact of automation. In my own field of data processing, the semi-skilled positions of data entry operator and peripheral equipment operator are being significantly changed. People that create and process punched cards are a vanishing species as more and more data is entered into the computer from terminals, much of it by the same people that create the data. Computer operators are finding that they are mounting and dismounting fewer and fewer tapes as applications rely more and more on randomly addressed disk storage. Not only is the capacity of disk storage units increasing, but they are frequently fixed disks requiring little if any operator attention. We have a very large computer installation where I work, and the computer power there has more than doubled in the past two years. In that same period of expanding capability, we have reduced the number of computer operators from 85 to 75. And the operators that remain are handling more challenging assignments: console operators, trouble shooters, telecommunications specialists, etc.

In the office, technology is also drastically changing the way we do things. Office automation, including word processing, message and document handling, electronic mailboxes, etc., greatly increases the output of people that handle information. But this will not result in fewer jobs. For now and for the forseeable future, our information society requires people not only to create information but also to document, process and distribute that information. The job of secretary heads the list of the top ten jobs for current and future openings.

These jobs place a premium on the proper use of the English language. Although word processing systems frequently include the capability to find spelling errors, to show the correct spelling of a word or even to suggest synonyms, it will be a long time before the computer will be able to signal that you wrote "there" when you should have written "their", or "compliment" instead of "complement" of "a group of boys were" instead of a "group of boys was".

The use of local area networks greatly diminishes the requirement for voice communication over the phone. Other advances in telephone equipment and services will significantly reduce or eliminate the telephone barrier that has plagued deaf people in the past. In a way, although oral skills can be very helpful, the relative importance of speech and hearing is being overshadowed by an increased importance in reading and writing.

The Employer's Role in Education

Since early in this century, business and industry have worked cooperatively to integrate actual work experience into a student's academic preparation. But until the 1970's, deaf students had few opportunities to participate in this form of cooperative education. Now large numbers of deaf college students are working for business, industry and government during their summer vacations or during an academic quarter. During the past 10 years, IBM has had a special program to find capable deaf college students and provide them with co-op employment in the areas of their academic majors. In the past three years, we have averaged about 60 such students and, on graduation, have hired about 15 professionals each year.

For many years, IBM has had a Faculty Loan program that allowed a professional employee to teach on a college campus for an academic year while remaining on the company payroll. Initially, this program was used in conjunction with colleges having a high percentage of minority students. In recent years, this program has been extended to include other populations. In particular, IBMers have been loaned to NTID, Gallaudet, CSUN, and Ohlone College. By bringing students into the IBM work environment and IBMers into the school environment, we both learn and profit from the interaction.

IBM is also pleased to have played a role in the recent publication of Signs for Computing Terminology. Computer literacy is fast becoming a necessity for all. As mentioned in its Introduction, "It is hoped that this book will spur improved communication with and among deaf persons who are involved, either directly or indirectly, in this exciting and dynamic field, as well as facilitate the entrance of many more."

Conclusions

The world of employment is becoming increasingly sophisticated, not only as regards computing technologies such as artificial intelligence, networks, speech recognition, but in many other areas as well: laser disks, fiber optics, satellite communications, genetic engineering, energy conservation, etc. A greater proportion of well-educated people are required. Retraining will be an almost continuous process as technology modifies the way we do things at all levels of employment. Whether technology is a villain or a hero will depend on one's flexibility and on one's ability and willingness to learn new things.

The use of technology in the educational process will certainly help, both in formal schooling as well as in on-the-job retraining programs. But more important than the educational methodology is the educational content: (1) Education must reflect the changing job market; (2) Students must learn basic principles and acquire real understanding, not just techniques and procedures; (3) English language skills are fundamental to an ever-growing share of the jobs now and in the future.

Our deaf students can compete. As Mr. Pluimer said, "Negativism paralyzes." We need to have high expectations of our students. And those expectations must begin with parental expectations and then be continued by teachers, counselors, administrators, and employers. And finally, those expectations must be shared by the students themselves. When this positive outlook is coupled with our combined best efforts, deaf people will share appropriately in the benefits of technology.

IV.

PERSPECTIVES OF A DEAF ADULT AND REHABILITATION
California Department of Rehabilitation

Judy Tingley

Before I begin, I would like to acknowledge the contribution that humans still make to the communication process and thank my human interpreter. It is a bit disconcerting to learn that someday she will be replaced by a machine.!

I have been asked to speak from the perspective of rehabilitation and from the perspective of a deaf adult. Those two roles are not mutually exclusive. By training and previous experience, I have been an educator from grade school to college where I taught at NTID. I am still an educator...of slow learners in Sacramento. As a state coordinator of rehabilitation services for deaf persons, my department is a conduit from school to employment. I can only reiterate the points raised by Steve Jamison of IBM, not because I lack originality but because they are as important to rehabilitation as they are to business and industry.

As we look back over the training and workshops this week, we are reminded of the current buzzword: Transitions. We need to focus attention on the future when the student goes out into the world of work and competition, living independently in the community. These students are going to be competing and living with hearing young people who will have had a lot of exposure to and training with computers. Much discussion this week about technology has involved technology other than computers; however, it is difficult not to keep coming back to them. We need to think of computer technology not only as a resource and support for learning, but also as a teaching subject in itself. One aspect of this is to consider teaching programming at school. There are three major reasons for doing this. One, obviously, is to prepare the students for jobs and for postsecondary education. Another is to prepare students for citizenzhip in a computer-based society. Third, is to use programming to enhance a student's general intellectual ability. Let us focus on the first two areas.

There are more jobs today that involve the use of computers and that require knowledge of programming. Many high schools are teaching programming to their students as a required course or as an elective. Deaf students will be competing with those hearing peers in schools and in their future jobs. Our deaf students should not be left behind. Schools that are seriously involved with prevocational or preacademic training are beginning to offer courses in several computer languages--Cobol, Pascal, Fortran are often taught in high school stoday. Mention has frequently been made of Logo, a powerful language that can be taught to even very young children. There are also programmable toys that would make the teaching of programming a lot of fun for our students. (It is strange to find students who know a lot more about computers and programming than their teachers! This week may be a way to catch up with them!)

Steve Jamison has noted the contributions that IBM has made to schools, and it should be added that IBM has contributed to rehabilitation, also. IBM and other businesses have been visible here this week. That says something for us: every school should nurture contacts with local businesses and industry. Each should have a Business/Employment Advisory Committee to offer technical advice and information about the labor market. This would help the schools know that the labor market requires in the way of trained workers and help the schools select hardware.

As consumers and citizens, our students need to understand processes: how things work and what to do when they don't. A lot of those "things" involve computers. Students as consumers need to know how to handle problems with their bank accounts, charge accounts, and other billings. It used to be that the customer was always right. Not any more. The computers are right.

In addition, students can be given opportunities for real world programming. They can be given school-related tasks to see the application of their skills. Older students can be involved in developing CAI for younger students. Most of all, it is important that our students have an opportunity to transcend the dependency role as consumer or victim. We also need to look at the programs chosen for our students to determine the locus of control. We can use programs that allow students to control how they learn, to choose the sequence of content, the rate they will read, process, and think.

Shifting our week's review to other forms of technology that have been discussed there, it is interesting to note networking. Telecommunication is always exciting. In California, as you may know, we have a program that is the result of legislation introduced by deaf consumer advocates which requires the telephone company to make TDD's available to deaf persons at no extra cost. Deaf advocates pushed for specifications in the equipment that forced the TDD technology closer to computers, knowing that the larger the critical mass the lower the production costs and the larger the number of people who could be accessed.

Also in California we have new legislation which requires the telephone companies to provide TDD-voice relay services. Advocates would like to keep the telephone companies involved in order to take advantage of the most sophisticated technology possible.

It is interesting to be deaf at my age and to look back to the time not so long ago when we did not have TDDs, computers, or captioned films. When we consider today's deaf children, we realize they were born into a world where these things may be pretty much taken for granted. I hope they remain excited about them, however, and I hope that we as educators can maintain that excitement and take advantage of what technology has to offer. This week has brought together education, business, and--in a small way--rehabilitation. All of the education you provide the students with the support and interest of business will make rehabilitation's job much easier.